U.S. Army
Environmental
Center

SIERRA ARMY DEPOT
Lassen County, California

DRMO Trench Area

Final

Record of Decision/Remedial Action Plan

Contract DAAA15-90-D-0011
Task Order 3

March 1998

MONTGOMERY WATSON

SIERRA ARMY DEPOT
LASSEN COUNTY, CALIFORNIA

FINAL
RECORD OF DECISION/REMEDIAL ACTION PLAN
DRMO TRENCH AREA

CONTRACT DAAA15-90-D-0011
TASK ORDER 3

Prepared for:

UNITED STATES ARMY
ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

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March 1998

SIERRA ARMY DEPOT
RECORD OF DECISION/REMEDIAL ACTION PLAN
DRMO TRENCH AREA

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DRMO TRENCH AREA
RECORD OF DECISION/REMEDIAL ACTION PLAN
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ACRONYMS AND ABBREVIATIONS

APCD	Air Pollution Control District
ARAR	applicable or relevant and appropriate requirement
AVG	average
bgs	below ground surface
BNA	Base-Neutral and Acid Extractable Organics
BRA	baseline risk assessment
Cal-EPA	California Environmental Protection Agency
CCR	California Code of Regulations
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	compound of concern
DCB	Dichlorobenzene
DPDO	Defense Property Disposal Office
DRMO	Defense Reutilization and Marketing Office
DTSC	Department of Toxic Substances Control
EP	Extraction Procedure
ESE	Environmental Science and Engineering, Inc.
°F	Degrees Fahrenheit
FFSRA	Federal Facility Site Remediation Agreement
FS	Feasibility Study
GAC	granular activated carbon
GPR	Ground Penetrating Radar
HHRA	Human Health Risk Assessment
HI	hazard index
HQ	hazard quotient
HWM	hazardous waste management
JMM	James M. Montgomery, Consulting Engineers, Inc.
LUFT	Leaking Underground Fuel Tank
µg/dL	Micrograms per deciliter
µg/g	Micrograms per Gram
mg/kg	milligrams per kilogram
msl	mean sea level
NCP	National Contingency Plan
NPL	National Priorities List
OC	organochlorine
PAH	polycyclic aromatic hydrocarbons
PC	permeability constant
PCB	polychlorinated biphenyls
PWQO	Protective Water Quality Objective
RAP	remedial action plan
RfD	reference dose
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study

ACRONYMS AND ABBREVIATIONS
(Continued)

RME	reasonable maximum exposure
ROD	record of decision
RWQCB	Regional Water Quality Control Board
SARA	Superfund Amendments and Reauthorization Act of 1986
SF	slope factor
SIAD	Sierra Army Depot
SVE	soil vapor extraction
SVOC	semivolatile organic compound
SWRCB	State Water Resources Control Board
TBC	to be considered
TCE	trichloroethene
TMV	toxicity, mobility, or volume
TPH	Total Petroleum Hydrocarbon
TPH-diesel	total petroleum hydrocarbons as diesel
TPH-gas	total petroleum hydrocarbons as gasoline
TRPH	Total Recoverable Petroleum Hydrocarbon
USAEC	U.S. Army Environmental Center
USAEHA	U.S. Army Environmental Hygiene Agency
USATHAMA	U.S. Army Toxic and Hazardous Materials Agency
USDI	U.S. Department of the Interior
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound
WDR	waste discharge requirements

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1.0 DECLARATION

1.1 SITE NAME AND LOCATION

Defense Reutilization and Marketing Office Trench Area, Sierra Army Depot, Lassen County, California.

1.2 STATEMENT OF BASIS AND PURPOSE

This Record of Decision (ROD)/Remedial Action Plan (RAP) presents, for the Defense Reutilization and Marketing Office (DRMO) Trench Area, the selected response actions that were chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments Reauthorization Act of 1986 (SARA), to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), and Chapter 6.8 of the California Health and Safety Code. Further, these actions are also being taken in response to the California Water Code. This ROD/RAP explains the factual and legal basis for selecting the response actions for the DRMO Trench Area. The information supporting the selected response actions is contained in the Administrative Record for this site. The State of California, as represented by the Department of Toxic Substances Control (DTSC) and the Lahontan Regional Water Quality Control Board (RWQCB), concur with the response actions selected by the U.S. Army (Army).

Section 25356.1(e) of the California Health and Safety Code requires that a RAP approved by DTSC include a non-binding preliminary allocation of financial responsibility among all identifiable potentially responsible parties. Upon consideration of all the evidence, DTSC has concluded that the preliminary non-binding allocation of financial responsibility in this ROD/RAP is as follows:

- U.S. Army, Sierra Army Depot: 100 percent

The content of this ROD/RAP is based on recommendations in the U.S. Environmental Protection Agency's (USEPA's) Interim Final Guidance on Preparing Superfund Decision Documents (USEPA, 1989a).

1.3 ASSESSMENT OF THE SITE

The DRMO Trench Area consists of three source areas of contamination: the DRMO Open Trench, the Burn and Debris Area, and the Active DRMO Yard. The activities conducted at the DRMO Open Trench and Burn and Debris Area have ceased while the Active DRMO Yard continues to be used for the management, storage, and salvage of surplus materials.

1.3.1 DRMO Open Trench Soil

The DRMO Open Trench is a former disposal trench approximately 290 feet long, 40 feet wide, and 10 feet deep. The trench was reportedly used extensively from 1942 to 1973 and in a limited capacity from 1973 to 1987 for disposal of waste oils, oil sludge, solvents, and cleaning fluids from vehicle maintenance activities. Laboratory analyses indicate that the soil at the DRMO Open Trench is contaminated with volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides, metals, total petroleum hydrocarbons as gasoline (TPH-gas) and TPH as diesel (TPH-diesel). SVOC and VOC contamination extends from ground surface to the soil/groundwater interface (approximately 100 feet below ground surface) beneath portions of the open trench.

1.3.2 Burn and Debris Area Soil

The Burn and Debris Area is an area, approximately 175 feet by 55 feet, containing a surficial layer of debris from burning activities. VOCs, polychlorinated biphenyls (PCBs), dioxin/furans, and metals have been detected in surface and near-surface soil at the Burn and Debris Area. The chemicals detected in the Burn and Debris Area have not impacted groundwater beneath the site due to the low mobility of the compounds and the absence of a driving force to move the chemicals.

1.3.3 Active DRMO Yard Soil

The Active DRMO Yard is a fenced area, approximately 550 feet wide by 1,600 feet long, east of the open trench. This area is used for the storage of surplus and scrap materials that can be reutilized or sold by the Army. Pesticides, PCBs, metals, and petroleum hydrocarbons have been detected in surface and subsurface soil within the Active DRMO Yard. The Active DRMO Yard is also a potential source of VOCs in groundwater beneath the site. Discrete VOC sources were not identified during the 1993 Group I and II Follow-Up RI. However, elevated levels of trichloroethene (TCE) were detected in soil gas at the Active DRMO Yard.

1.3.4 Groundwater

Groundwater has been characterized beneath all three of the source areas at the DRMO Trench Area. The TCE detected in the monitoring well and HydroPunch groundwater samples collected in the vicinity of the open trench is interpreted to be a result of the soil contamination in the open trench. The origin of the TCE detected in the groundwater samples collected from beneath the Active DRMO Yard is uncertain but may be due to unidentified source(s) located in the active yard.

SVOCs were detected in one HydroPunch groundwater sample collected directly beneath the open trench. The SVOCs are interpreted to be a result of migration of these compounds through the vadose zone. Based on the chemical properties of the SVOCs and their concentrations, they are not expected to migrate at a significant rate.

1.4 DESCRIPTIONS OF THE SELECTED REMEDIES

1.4.1 DRMO Open Trench Soil

The selected remedy will utilize soil vapor extraction (SVE) and bioventing to address the contaminated soil at the DRMO Open Trench by reducing concentrations of VOCs, SVOCs, and petroleum hydrocarbons in soil. SVE treats the soil in situ using vacuum extraction vents. Air flow through the soil to the extraction vents removes volatile constituents from the soil. The extracted vapors will be treated using granular activated carbon (GAC) to remove VOCs from the extracted vapors and prevent discharge of constituents to the air. Once solvent and SVOC concentrations in the extracted vapors reach minimum levels, the SVE system would be converted to an in situ bioventing system by reversing the direction of air flow. Bioventing would utilize air injection to stimulate naturally occurring aerobic bacteria that biodegrade those chemical constituents not removed via SVE.

The zone of soil contamination in the open trench that requires remediation is estimated to be from the bottom of the trench to 15 feet below the bottom of the trench. Prior to SVE/bioventing treatment, the selected remedy involves backfilling approximately 10 feet of imported clean soil into the trench. Backfilling will prevent rapid air exchange between the extraction/injection system and the atmosphere. It will also enable SVE/bioventing to treat the entire volume of soil from the bottom of the trench to 15 feet below the bottom of the trench, without having to excavate and remove any soil.

The selected remedy for the DRMO Open Trench soil is described in more detail in Sections 2.7, 2.8, 2.9, and 2.10.

1.4.2 Burn and Debris Area Soil

The selected remedy will utilize excavation and off-site disposal to address the contaminated soil at the Burn and Debris Area by reducing concentrations of VOCs, PCBs, dioxin/furans, and metals in soil. It is assumed that approximately 700 cubic yards (1,100 tons) of soil from the Burn and Debris Area will be excavated and transported to a commercial off-site facility for treatment and disposal. Given the levels of copper and lead detected in the soils, it is assumed that the soil would require treatment for metals stabilization prior to disposal in an appropriate land disposal facility. Additional characterization of the extent of contaminated soil prior to or during removal of the soil may reduce the volume to be excavated as well as the cost. The site would be backfilled with clean soil where necessary to promote runoff of surface water.

The selected remedy for the Burn and Debris Area soils is described in more detail in Sections 2.7, 2.8, 2.9, and 2.10.

1.4.3 DRMO Trench Area Groundwater

The selected remedy will address the contaminated groundwater at the DRMO Trench Area by utilizing attenuation processes that occur naturally within the aquifer to decrease chemical concentrations and reduce migration of TCE to rates that are acceptable to the State of California. The site-specific hydrogeologic conditions (i.e., flat hydraulic gradients and low hydraulic conductivities) are highly favorable for use of natural attenuation at the DRMO Trench Area. The major components of the selected remedy are:

- Source removal via SVE/bioventing treatment of DRMO open trench soils (as described in Section 1.4.1)
- Installation of additional monitoring wells to complete the groundwater monitoring network
- Evaluation of natural attenuation of TCE in groundwater
- Source removal of soil gas hot spot at the DRMO Active Yard via SVE treatment

Groundwater monitoring of selected wells will be performed to evaluate attenuation and degradation of the TCE plume. Groundwater sampling will be conducted quarterly for one year, then annually thereafter. The Army will submit status reports on the results of groundwater monitoring to the State of California. Groundwater modeling may also be conducted, if warranted. Institutional controls would be utilized to restrict the use of groundwater at the site during long-term monitoring.

In the future, if the selected remedy is no longer acceptable to the State of California or the Army, a contingency alternative will be implemented. However, if the Army and the State do not agree with each other, either the State or the Army can invoke dispute resolution via Section 12 of the Federal Facility Site Remediation Agreement (FFSRA). The contingency alternative consists of groundwater extraction and treatment; treated groundwater would be disposed of by reinjection or by another method that is acceptable to the State.

The selected remedy also includes remediation of soil within a localized area of the Active DRMO Yard where elevated levels of TCE in soil gas were detected. An SVE system would be constructed to remediate possible TCE in soil within the area of a soil gas anomaly. The soil remediation would eliminate the possibility that the elevated soil gas levels represent a point source for TCE in groundwater beneath the site.

The selected remedy for the DRMO Trench Area groundwater is described in more detail in Sections 2.7, 2.8, 2.9, and 2.10.

1.5 STATUTORY DETERMINATIONS

1.5.1 DRMO Open Trench Soil

The selected remedy for the DRMO Open Trench soil satisfies the statutory requirements of CERCLA §121 and §120(a)(4), as amended by SARA, in that the following mandates are attained:

- The selected remedy is protective of human health and the environment.

- The selected remedy complies with federal and state requirements that are legally applicable or relevant and appropriate to the remedial action.

- The selected remedy is cost effective.

- The selected remedy utilizes permanent solutions and alternative treatment technologies or resource recovery technologies, to the maximum extent practicable.

- The selected remedy satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element.

1.5.2 Burn and Debris Area Soil

The selected remedy for the Burn and Debris Area soil satisfies the statutory requirements of CERCLA §121 and §120(a)(4), as amended by SARA, in that the following mandates are attained:

- The selected remedy is protective of human health and the environment.

- The selected remedy complies with federal and state requirements that are legally applicable or relevant and appropriate to the remedial action.

- The selected remedy is cost effective.

- The selected remedy utilizes permanent solutions and alternative treatment technologies or resource recovery technologies, to the maximum extent practicable.

- The selected remedy satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element.

1.5.3 DRMO Trench Area Groundwater

The selected remedy with the contingency alternative for the DRMO Trench Area groundwater satisfies the statutory requirements of CERCLA §121 and §120(a)(4), as amended by SARA, in that the following mandates are attained:

- The selected remedy with the contingency alternative is protective of human health and the environment.

- The selected remedy with the contingency alternative complies with federal and state requirements that are legally applicable or relevant and appropriate to the remedial action.

- The selected remedy with the contingency alternative is cost effective.

- The selected remedy with the contingency alternative utilizes permanent solutions and alternative treatment technologies or resource recovery technologies, to the maximum extent practicable.

- The selected remedy with the contingency alternative satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element.

Because the selected remedy will result in contaminants remaining on site above the target cleanup levels during the remedial actions, 5-year site reviews will apply to these actions [CERCLA § 121(c) and 40 CFR 300.430 (f)(4)(ii)].

2.0 DECISION SUMMARY

This section of the ROD provides an overview of the site-specific factors and analyses that led to the selection of the response actions for the DRMO Trench Area.

2.1 SITE NAME, LOCATION, AND DESCRIPTION

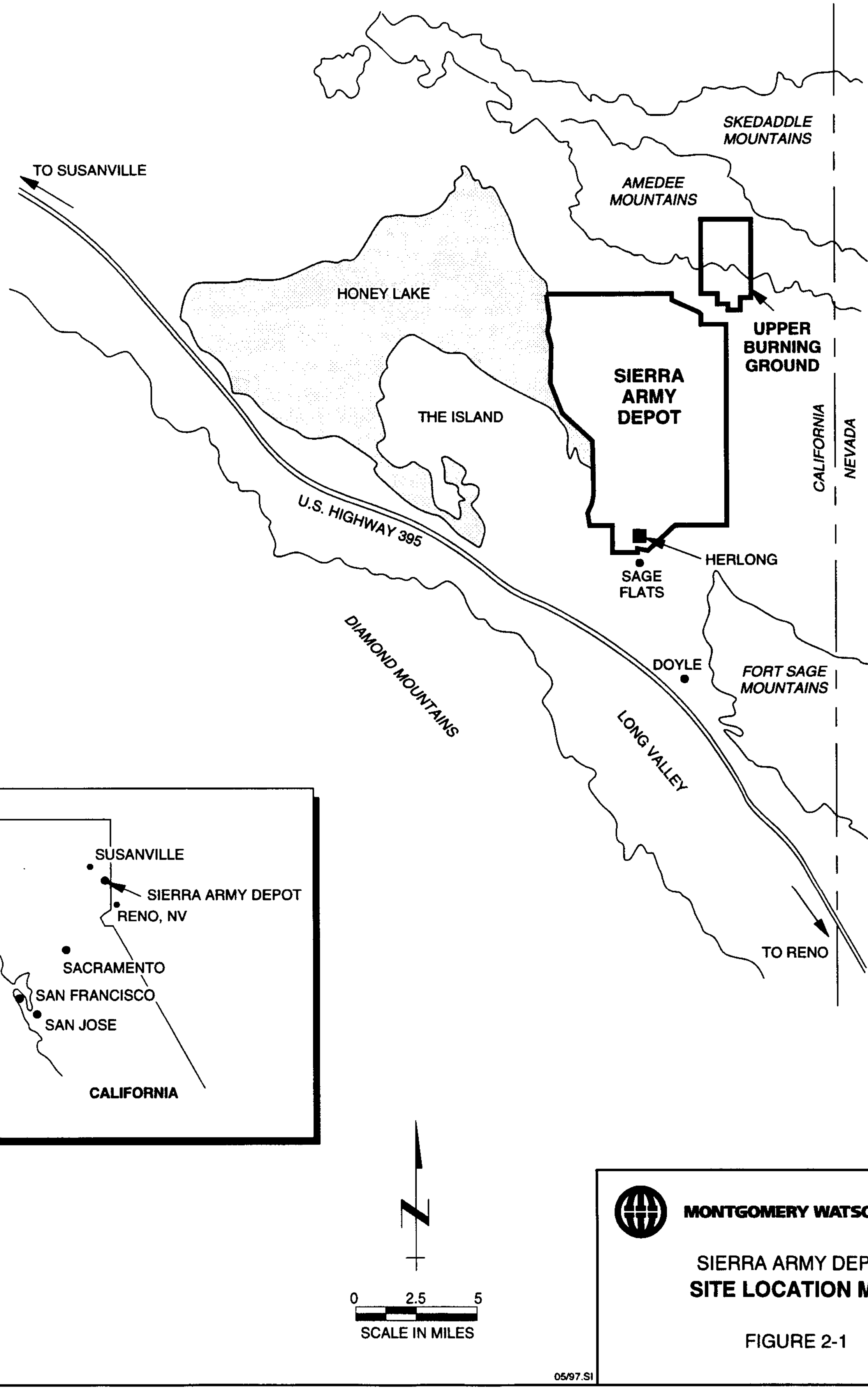
Sierra Army Depot (SIAD) is an active military facility located in Honey Lake Valley of Lassen County in northeast California, approximately 4 miles west of the California-Nevada state border and 5 miles east of U.S. Highway 395 (Figure 2-1). The two largest communities near SIAD are Susanville, California (county seat of Lassen County, located 40 miles northwest of SIAD), and Reno, Nevada (located 55 miles southeast of SIAD). Other neighboring communities include Herlong, Sage Flats (located near the southern entrance to the Main Depot), and Doyle (located 8 miles south of SIAD), all in California.

The total area of SIAD is 37,060 acres and is composed of two sites; the Main Depot (33,163 acres) and the Upper Burning Ground (3,897 acres), located 10 miles northeast of Herlong. Honey Lake, located adjacent to SIAD on the northwest border, encompasses 60,523 acres.

The DRMO Trench Area is located approximately one-half mile east of Main Magazine Road in the southern portion of SIAD (Figure 2-2). The DRMO Trench Area includes the DRMO Open Trench, the Burn and Debris Area, and the Active DRMO Yard (Figure 2-3). The DRMO Open Trench is a former disposal trench approximately 290 long, 40 feet wide, and 10 feet deep. The Burn and Debris Area is an area, approximately 175 feet by 55 feet, containing a surficial layer of debris from burning activities. The Active DRMO Yard is a large area, approximately 1,600 feet long by 550 feet wide, currently used for the storage and salvage of materials and supplies.

2.1.1 Physiography

Honey Lake Valley where SIAD is located is situated in the Basin and Range physiographic province. The area is characterized by northwest-trending mountains that rise 2,000 to 3,000 feet above the valley floor. The valley is bordered on the southeast by the Fort Sage and Virginia Mountains, on the northeast by the Skedaddle and Amedee Mountains, on the southwest by the Diamond Mountains, and on the north by the Shaffer Mountains. The Amedee, Diamond, and Fort Sage Mountains are proximate to SIAD. The main depot has little topographic relief and varies in elevation from 3,986 feet at lake level to approximately 4,134 feet above mean sea level (msl) at Herlong, California. The southern portion of the main depot lies on a sandy terrace and is somewhat higher in elevation than the northern part, which lies on the lower lake levels. The Upper Burning Ground, a detached area of SIAD located on the edge of the Amedee Mountains, is located on rugged terrain with considerably more topographic relief than the main depot. The Upper Burning Ground ranges in elevation from 4,039 feet to 5,480 feet above msl (Benioff, et al., 1988).



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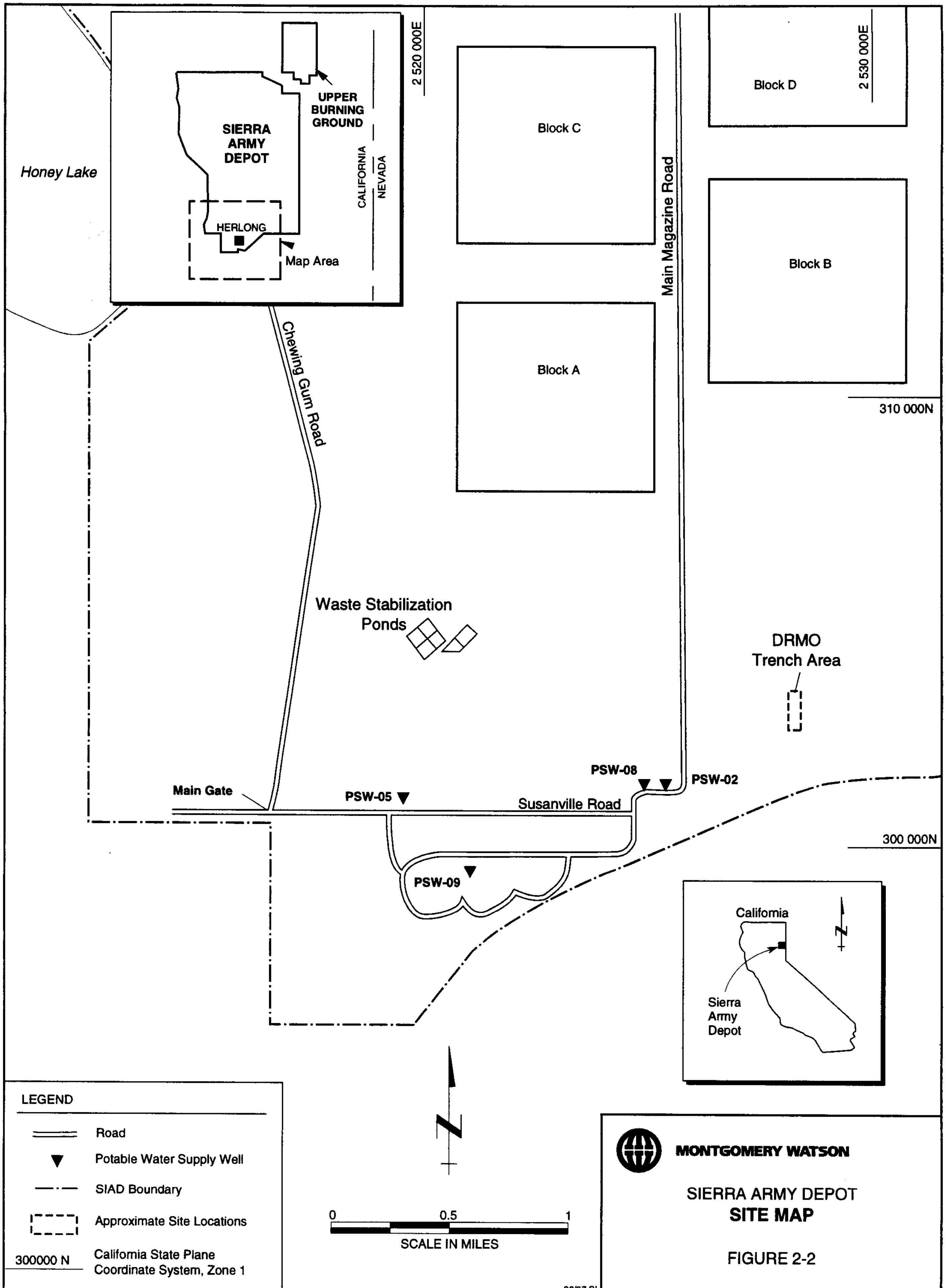
SIERRA ARMY DEPOT

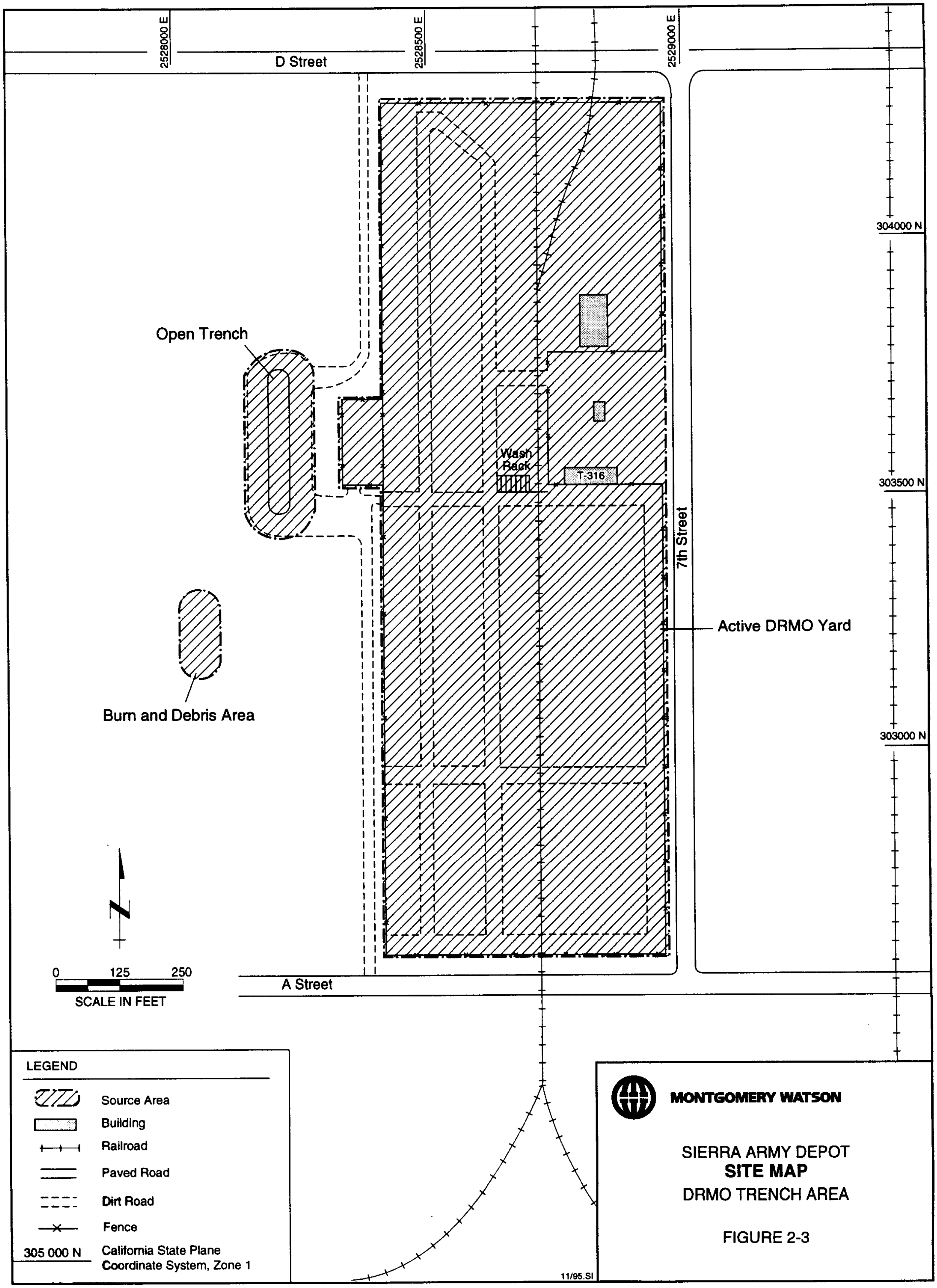
SITE LOCATION MAP

FIGURE 2-1



SIERRA ARMY DEPOT
SITE MAP

FIGURE 2-2


2528000 E
2528500 E
2529000 E
D Street
304000 N
303500 N
303000 N
Open Trench
Wash Rack
T-316
7th Street
Active DRMO Yard
Burn and Debris Area
0
125
250
SCALE IN FEET
A Street
LEGEND
Source Area
Building
Railroad
Paved Road
Dirt Road
Fence
305 000 N
California State Plane Coordinate System, Zone 1
MONTGOMERY WATSON
SIERRA ARMY DEPOT
SITE MAP
DRMO TRENCH AREA
FIGURE 2-3
11/95.SI

2.1.2 Geology of Honey Lake Basin

Honey Lake Valley lies at the junction of three geologic provinces: the western edge of the Basin and Range, the northeastern edge of the Sierra Nevada, and the southeastern edge of the Modoc Plateau. A northwest-trending fault system, the Walker Lane, extends from Las Vegas to Honey Lake Valley.

Honey Lake Valley is underlain by unconsolidated to semiconsolidated sediments and volcanic rocks overlying granitic bedrock. Granitic bedrock forms the lower impermeable boundary to groundwater flow and is 5,000 to 6,000 feet below ground surface (bgs) (Handman, et al., 1990). Unconsolidated and semiconsolidated Pliocene and Holocene basin-fill deposits underlie, interfinger with, and overlie the consolidated volcanic rocks along the entire north and northeast margins of the basin. These semiconsolidated deposits consist of thick layers of volcanic tuff and ash that typically were deposited in shallow lakes along the lacustrine and fluvial deposits of clay, silt, and minor amounts of sand. The unit comprises the majority of the basin fill.

Honey Lake occupies part of an area previously covered by a much larger, prehistoric water body known as Lake Lahontan. Quaternary lacustrine deposits of sands and gravels predominate in the western portions of the basin, and silts and clays predominate in the eastern side of the basin.

Alluvial fans of Quaternary age consisting of poorly sorted deposits ranging in size from clay to boulders have accumulated along the base of the mountain fronts. The distal portions of the fans interfinger with the predominantly fine-grained lake deposits toward the center of the basin.

2.1.3 Surface Water Resources

More than 40 streams flow from the Diamond, Fort Sage, and Virginia Mountains and the northern volcanic uplands towards the center of the topographically closed basin. The largest streams in the basin are the Susan River and Baxter Creek, which enter the valley from the northeast, and Long Valley Creek, which enters the valley from the southeast. With the exception of the Susan River, all of these streams are intermittent and only reach the valley floor in the wet years (USDI, 1954). No surface drainage traverses the main depot of SIAD. Three intermittent streams drain off the Upper Burning Ground to terminate in the region between this area and the main depot. The most prominent surface water feature in the basin is Honey Lake, which has a large seasonal fluctuation in area and volume.

No intermittent or perennial surface water features are present in the vicinity of the DRMO Trench Area.

2.1.4 Groundwater Resources

Recharge to the groundwater system in Honey Lake Valley is from direct infiltration of precipitation and snow melt into consolidated rock and unconsolidated basin fill deposits, infiltration of water from streams, seepage of irrigation water, and subsurface inflow from adjacent areas. The major sources are direct infiltration of precipitation in upland areas and infiltration of stream flow in alluvial fan areas.

The depth to the water table at SIAD is variable. The extreme heterogeneity of the sediments can influence water table elevations, and lenses of less permeable sediments support an elevated or perched water table in some locations.

Using groundwater levels recorded in May 1995 from monitoring wells and piezometers installed during previous investigations, the 1990 Group I RI, 1991 Group II RI, 1992 Group I Follow-Up RI, 1993 Group I and II Follow-Up RI, and the 1995 DRMO Follow-Up RI, water table contour maps have been constructed. The groundwater gradient across the southern portion of the main depot generally trends to the north-northwest at about 0.0005 to 0.002. The gradient in the northern portion of the main depot is essentially flat.

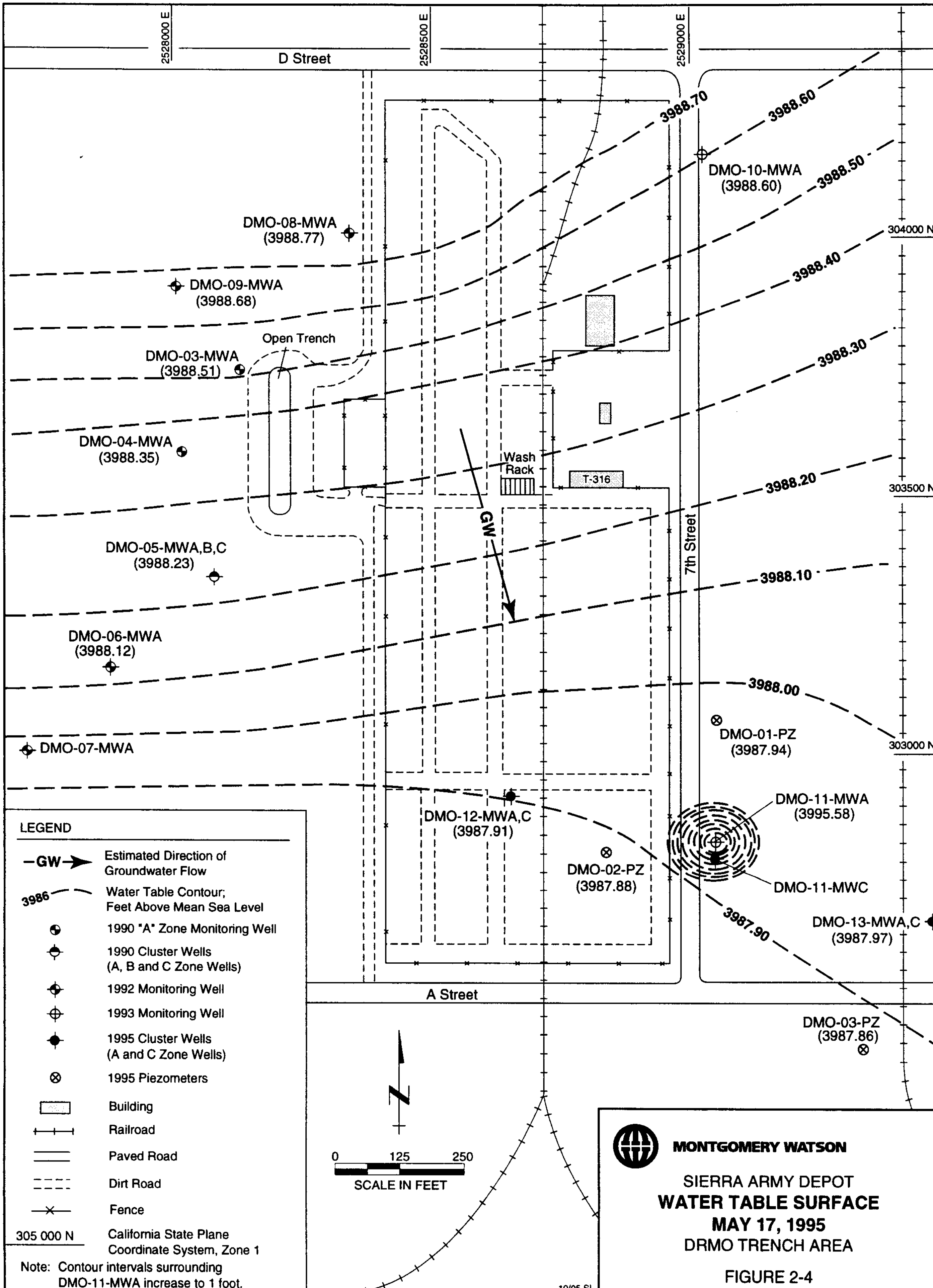
The regional groundwater gradient in the vicinity of the DRMO Trench Area is essentially flat. Groundwater-level data collected from the 11 water table monitoring wells and three water table piezometers at this site show that the groundwater flow is primarily to the south southeast with localized gradients ranging from 0.0002 to 0.01. Figure 2-4 presents a groundwater contour map for the site based on May 1995 water level data. A localized groundwater mound is detected in one well at the southeast corner of the Active DRMO Yard. The groundwater elevation in this well is 7.5 feet higher than the groundwater elevations in the surrounding wells and piezometers. The cause of the higher groundwater elevation in DMO-11-MWA is not known. The depth to groundwater at these sites is approximately 100 feet bgs. Groundwater at the DRMO Trench Area is not currently used for potable water supply.

2.1.5 Biota

This section discusses the vegetation, wildlife, and land use issues associated with the DRMO Trench Area.

2.1.5.1 Vegetation. SIAD encompasses approximately 37,060 acres of a dried glacial lake bed and volcanic terrain located to the east of Honey Lake. The principal plant community at SIAD is greasewood-sagebrush, characteristic of the alkaline soil and semiarid climate of the area. The most common shrubs are greasewood, sagebrush, rabbit brush, spring hopsage, horsebrush, Mormon tea, and shadscale. The principal grasses include Great Basin wild, rye, saltgrass, squirrel tail, and annual cheatgrass. Common forbs include poverty weed, pepperwood, and tansy mustard. Several tree species have been introduced on base, including Chinese elm, Russian olive, Englemann spruce, Ponderosa pine, junipers, and cottonwoods, in order to decrease erosion. No threatened or endangered species are known to occur on base.

2.1.5.2 Wildlife. A variety of wildlife species is found in the general area of SIAD. Included among the species inventory for this area are four species of rabbits, 29 species of rodents, mountain lions, fox, mule deer, various reptiles and amphibians, and over 100 species of birds. From this diverse group, the Aleutian goose, mule deer, peregrine falcon, bald eagle, and game bird species are the most significant from an ecological assessment viewpoint. Mule deer and game birds are recreationally important species, while peregrine falcons, bald eagles, and Aleutian geese are rare, threatened, or endangered species.



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SIERRA ARMY DEPOT

WATER TABLE SURFACE

MAY 17, 1995

DRMO TRENCH AREA

FIGURE 2-4

2.1.6 Land Use

Lassen County has prepared a series of area plans covering selected portions of the county. SIAD is located within the Wendel Planning Area. Because of limited development and the sparse population, only four basic land-use categories are found in this planning area: grazing lands/open space, SIAD, irrigated lands, and town area. The largest land-use category is grazing lands/open space; most of the land is covered with native vegetation. Most of this land is in public ownership, with some land privately held. SIAD comprises approximately one-third of the total Wendel Planning Area. A few isolated patches of irrigated fields are found in the planning area. These are mainly irrigated pastures of mixed grasses and native grasses. Residences associated with ranching are included in some of these areas. The fourth category comprises the towns of Wendel, Herlong, and Sage Flats. Wendel is located northwest of SIAD; Herlong and Sage Flats are located to the southwest of SIAD near the southern entrance to the main depot (Figure 2-1). The planning area also contains Doyle State Wildlife Area, a wintering habitat for mule deer, located just south of SIAD.

2.2 SITE HISTORY AND ENFORCEMENT ACTIVITIES

SIAD began operations in 1942 including the reserve storage of inert supplies and materials owned by the U.S. Treasury Department. After construction of the Igloo Storage Area at SIAD, the receipt, storage, and issue of explosives was assigned to the depot. In 1954, additional missions of receipt, storage, and issue of guided missiles and propellant fuels were also assigned to SIAD. The current missions of SIAD are to receive, store, issue, and renovate munitions; and to efficiently and safely demilitarize surplus ammunition. It also provides storage and maintenance of operational stocks and tactical support systems. All operations are conducted in accordance with approved environmental guidelines.

In 1991, SIAD signed a Federal Facility Site Remediation Agreement (FFSRA) with the California Department of Health Services, Toxic Substances Control Program (now the DTSC) and the California RWQCB-Lahontan Region. The purpose of the FFSRA is to establish procedures and schedules for investigation and remediation of contamination and facilitate cooperation and exchange of information. There have been no enforcement actions at the DRMO Trench Area.

The DRMO Trench Area, previously referred to as the Defense Property Disposal Office (DPDO), has been divided into three subareas, the DRMO Open Trench, the Burn and Debris Area, and the DRMO Active Yard. The DRMO Open Trench was used for the disposal of wood pallets, cardboard tubing, waste oil, sludge, and solvents (Benioff, et al., 1988). The DRMO Open Trench was used extensively from 1942 to 1973 and in a limited capacity from 1973 to 1987 (ESE, 1983; USAEHA, 1988). Between 1942 and 1973, approximately 190 liters per day of waste oils, oil sludge, solvents, and cleaning fluids from vehicle maintenance activities in Buildings 208, 209, and 210 were disposed of and burned in the DRMO Open Trench (USATHAMA, 1979; ESE, 1983; USAEHA, 1988). It was originally reported that cleaning solvents, gasoline, and paint thinners from vehicle maintenance were disposed of in unlined ditches between Buildings 208, 209, and 210 (USATHAMA, 1979). However, interviews with long-term personnel familiar with the area indicated that the space between Buildings 208, 209, and 210 has been paved since construction in 1942 and that no ditches exist. The waste liquids from Buildings 208, 209, and 210 are believed to have been disposed of in the DRMO Open Trench (ESE, 1983).

The Burn and Debris Area was discovered approximately 120 feet southwest of the open trench during the 1990 field investigation. The area contains a layer of debris from burning activities. The surface of the Burn and Debris Area is elevated approximately 4 to 12 inches above the surrounding area indicating that the material may have been brought to the site and spread.

The Active DRMO Yard is a fenced area currently used for the storage and salvage of materials and supplies. Storage and salvage are suspected to be the only activities previously conducted at the DRMO Active Yard.

Several investigations have been conducted at the DRMO Trench Area. The dates, types of studies, and organizations involved in these are:

- Phase I Hazardous Waste Study, USAEHA (USAEHA, 1984; 1985)
- IRP 1990 Group I Remedial Investigation, James M. Montgomery, Consulting Engineers, Inc. (JMM) and E.C. Jordan (JMM and E.C. Jordan, 1991);
- IRP 1992 Group I Follow-Up Remedial Investigation, Montgomery Watson (Montgomery Watson, 1993);
- IRP 1993 Group I and II Follow-Up Remedial Investigation, Montgomery Watson (Montgomery Watson, 1994);
- IRP 1995 DRMO Trench Area Follow-Up Remedial Investigation, Montgomery Watson (Montgomery Watson, 1996).
- IRP Feasibility Study, Montgomery Watson (Montgomery Watson, 1997).

The Phase I Hazardous Waste Study conducted by USAEHA in 1984 consisted of the installation of five soil borings and two monitoring wells (USAEHA, 1984;1985). VOCs, SVOCs, and metals were detected in surface and subsurface soil. The monitoring wells were not sampled.

The 1990 Group I RI included a geophysical survey, soil gas survey, excavation of eight test pits, and installation of eight soil borings and three water table monitoring wells. Two rounds of groundwater sampling were conducted on the three new monitoring wells. VOCs were detected in soil gas near the open trench. VOCs, SVOCs, and metals were detected in surface and subsurface soil adjacent to and beneath the open trench. TCE was detected in the groundwater collected from the three monitoring wells.

Activities of the 1992 Group I Follow-Up RI included a soil gas survey; installation of eight soil borings, two HydroPunch borings, four water table monitoring wells, one intermediate ("B" zone) monitoring well, and one deep ("C" zone) monitoring well; and two rounds of groundwater sampling. In addition, eight discrete surface soil samples and one composite surface soil sample were collected from the Burn and Debris Area. VOCs and SVOCs were detected in soil collected from ground surface to the water table beneath portions of the open trench. Metals and pesticides were also detected in some soil beneath the open trench. TCE was detected in both HydroPunch groundwater samples collected from beneath the DRMO Active Yard. TCE was detected in groundwater monitoring wells at levels comparable to the previous rounds of sampling. High levels of metals and PCB-1260 were detected in soil at the Burn and Debris Area.

The 1993 Group I and II Follow-Up RI focused on an investigation of the Active DRMO Yard to locate possible VOC sources. The investigation included a soil gas survey, geophysical survey, excavation of four test pits with soil sampling, collection of 10 HydroPunch groundwater samples, and the installation of two water table monitoring wells. One additional soil boring was also drilled and sampled from beneath the open trench to the water table. A VOC source was not located in the DRMO Active Yard during the 1993 investigation. VOCs were detected in groundwater beneath the active yard. An anomalous groundwater elevation was detected in one well, DMO-11-MWA, at the southeast corner of the active yard.

The focus of the 1995 DRMO Follow-Up RI was to investigate the anomalous groundwater elevation detected in water table monitoring well DMO-11-MWA. The investigation included the installation of three pilot borings to 200 feet bgs, borehole geophysical logging of each pilot boring, installation and sampling of three cluster wells and three water table piezometers. The results of the investigation indicate that the groundwater mound is localized in the area around DMO-11-MWA and does not appear to significantly effect the groundwater movement in the remainder of the site. The cause of the groundwater mound is unknown.

2.3 HIGHLIGHTS OF COMMUNITY PARTICIPATION

The remedial investigation reports for the DRMO Trench Area were released to the public beginning in 1990. The feasibility study report for the DRMO Trench Area was released to the public in January 1997. The proposed plan for the DRMO Trench Area was released to the public in August 1997. These documents were made available to the public in both the Administrative Record file and in information repositories maintained at the following locations:

- Lassen County Free Library, Susanville, CA
- Sierra Army Depot Library, Herlong, CA
- Washoe County Library, Reno, CA

The notice of availability for these documents was published in the *Reno Gazette Journal* on August 18, 22, and 25, 1997 and the *Lassen County Times* between August 19, 1997 and August 26, 1997.

One public comment period was held from August 18, 1997 to September 17, 1997. A public meeting was held at Sierra Army Depot on September 3, 1997. Representatives from the Army, DTSC, and RWQCB were present at the meeting. The Responsiveness Summary, Section 3.0 of this ROD/RAP, contains responses to questions from the meeting. No written questions or comments were received by mail during the public comment period.

The public participation requirements of CERCLA §§113(k)(2)(B)(i-v) and 117 and §25356.1 of the California Health and Safety Code were met in the remedy selection. This ROD/RAP presents the selected response actions for the DRMO Trench Area at Sierra Army Depot, California, chosen in accordance with CERCLA (as amended by SARA), to the extent practicable, the NCP, and Chapter 6.8 of the California Health and Safety Code. Further, these actions are also being taken in response to the California Water Code. The basis for this decision is documented in the Administrative Record.

2.4 SCOPE AND ROLE OF RESPONSE ACTION

This ROD/RAP addresses the planned response actions for the DRMO Trench Area. The objectives of the response actions at the DRMO Trench Area are to: reduce contaminant concentrations in soil, implement an evaluation of natural attenuation to assess whether contaminant migration and degradation rates are within acceptable ranges to the State of California and the Army, and initiate institutional controls to prevent adverse exposure to contaminated groundwater at the DRMO Trench Area. In the future, if the selected remedy for groundwater is no longer acceptable to the State of California or the Army, a contingency alternative (pump-and-treat) will be implemented.

2.5 SUMMARY OF SITE CHARACTERISTICS

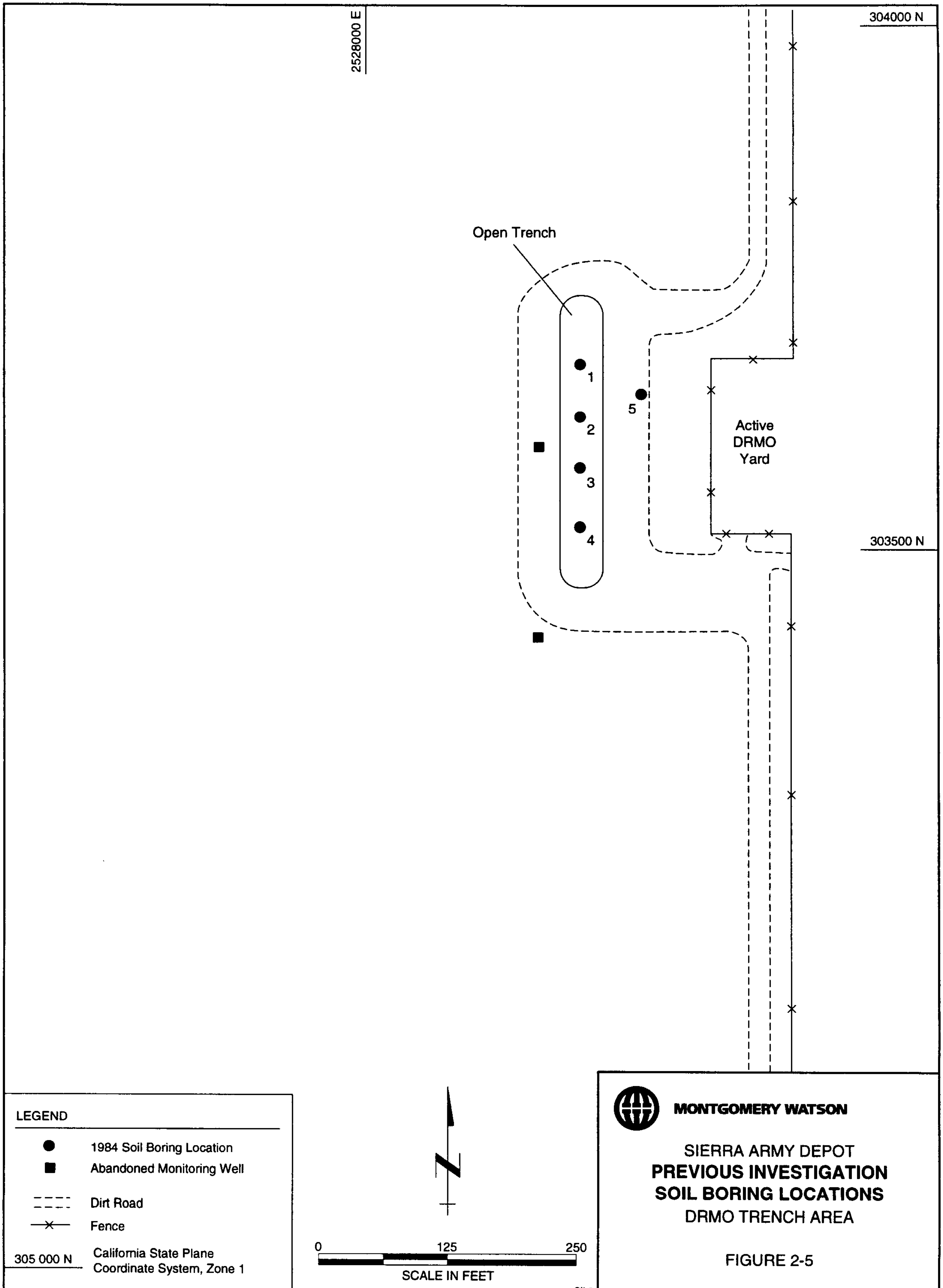
This section of the ROD/RAP provides an overview of the nature and extent of contamination at the DRMO Trench Area.

2.5.1 Soil

The distribution and extent of soil contamination at the DRMO Trench Area was assessed based on investigations conducted in 1984 by the U.S. Army Environmental Hygiene Agency (USAEHA) and during the 1990 Group I RI, 1992 Group I Follow-Up RI, and 1993 Group I and II Follow-Up RI by Montgomery Watson.

2.5.1.1 USAEHA Investigation. The DRMO Trench Area was investigated in 1984 by USAEHA (USAEHA, 1984). Five soil borings were installed and sampled to investigate potential soil contamination due to disposal of liquid industrial wastes (Figure 2-5). Four of the soil borings were drilled at 50-foot intervals in the bottom of the open trench. The fifth soil boring (Boring 5) was drilled about 50 feet east of the DRMO open trench to obtain background data. Depths of the soil borings ranged from 20 to 40 feet (Table 2-1). Soil samples from the borings were analyzed for VOCs and metals (Tables 2-1 and 2-2). Boring 2 was also analyzed for base-neutral and acid extractable organics (BNAs) (Table 2-3).

VOCs were detected in each of the four soil borings drilled within the open trench to depths of at least 15 feet below the bottom of the trench. Table 2-1 lists only those chemical parameters for



MONTGOMERY WATSON

SIERRA ARMY DEPOT
PREVIOUS INVESTIGATION
SOIL BORING LOCATIONS
DRMO TRENCH AREA

FIGURE 2-5

TABLE 2-1

CONCENTRATIONS OF VOCs IN SOILS IN THE DRMO TRENCH AREA
(μg/kg)[a]

Sample and Depth (ft)[b]	Ali-phatics	Benzene	Bromo-dichloro-methane	Chloro-benzene	1,2-Dichloro-benzene	1,3-Dichloro-benzene	1,4-Dichloro-benzene	1,2-Dichloro-ethane
1A, 0-2 5-15	<1	<1	<1	180	80	60	<1	
1B, 3-5	ND	<1	<1	4	350	100	150	<1
1C, 8-10	ND	<1	<1	<1	30	3	<1	<1
1D, 13-15	ND	<1	<1	<1	8	<1	3	<1
1E, 18-20	ND	<1	<1	<1	9	3	3	<1
2A, 0-2	25-50	<1	2	<1	780	12	130	17
2B, 3-5	300-500	<1	<1	<1	2,500	130	290	<1
2C, 8-10	250-500	<1	<1	3	200	15	50	<1
2D, 13-15	NA	NA	NA	NA	1,400	130	280	<1
2E, 18-20	ND	<1	<1	<1	3	<1	<1	<1
2F, 28-30	ND	<1	<1	<1	<1	<1	<1	<1
2G, 38-40	ND	<1	<1	<1	<1	<1	<1	<1
3A, 0-2	25-50	<1	<1	<1	960	50	175	<1
3B, 3-5	500-1,500	<1	10	190	2,000	140	600	<1
3C, 8-10	200-300	2	10	50	280	50	180	<1
3D, 13-15	ND	<1	<1	<1	22	4	8	<1
3E, 18-20	ND	<1	<1	<1	<1	<1	<1	<1
4A, 0-2	30-50	<1	<1	<1	440	100	250	<1
4B, 3-5	200-400	<1	<1	25	840	150	270	<1
4C, 8-10	50-75	<1	<1	13	740	70	120	<1
4D, 13-15	2-10	<1	<1	<1	50	5	50	<1
4E, 18-20	ND	<1	<1	<1	27	4	24	<1
5A, 10-12	ND	<1	<1	<1	<1	<1	<1	<1
5B, 13-15	ND	<1	<1	<1	<1	<1	<1	<1
5C, 18-20	ND	<1	<1	<1	<1	<1	<1	<1
5D, 23-25	ND	<1	<1	<1	<1	<1	<1	<1
5E, 28-30	ND	<1	<1	<1	<1	<1	<1	<1

TABLE 2-1 (Continued)

CONCENTRATIONS OF VOCs IN SOILS IN THE DRMO TRENCH AREA (µg/kg)[a]

Sample and Depth (ft)[b]	Ethyl-benzene	Ethyl Methyl Cyclo-hexane	Proply Cyclo-hexane	Tetra-Chloro-ethylene	Tetramethyl and Ethyl Dimethyl Benzenes	Toluene	Trichloro-ethylene	Trimethyl and Ethyl Methyl Benzene
1A, 0-2	<1	2-10	5-15	<1	20-40	<10	<1	20-40
1B, 3-5	<1	ND	ND	<1	ND	80	3	ND
1C, 8-10	<1	ND	ND	<1	ND	<10	<1	ND
1D, 13-15	<1	ND	ND	<1	ND	<10	<1	ND
1E, 18-20	<1	ND	ND	<1	ND	<10	<1	ND
2A, 0-2	8	20-50	50-100	<1	200-400	<10	130	100-200
2B, 3-5	<1	300-400	100-200	<1	200-400	<10	125	200-400
2C, 8-10	2	5-10	20-40	<1	20-40	<10	90	100-200
2D, 13-15	NA	NA	NA	NA	NA	NA	NA	NA
2E, 18-20	<1	ND	ND	<1	ND	<10	<1	ND
2F, 28-30	<1	ND	ND	<1	ND	<10	<1	ND
2G, 38-40	<1	ND	ND	<1	ND	<10	<1	ND
3A, 0-2	<1	40-80	10-30	<1	100-300	<10	1	100-150
3B, 3-5	30	40-80	100-300	3	100-300	<10	710	1,000-3,000
3C, 8-10	10	40-80	50-150	3	300-500	<10	620	1,000-1,500
3D, 13-15	<1	ND	ND	<1	ND	<10	<1	ND
3E, 18-20	<1	ND	ND	<1	ND	<10	<1	ND
4A, 0-2	12	10-20	10-20	<1	50-100	<10	45	50-100
4B, 3-5	47	100-300	100-300	<1	50-150	<10	92	50-150
4C, 8-10	40	150-200	25-50	<1	300-500	<10	23	300-500
4D, 13-15	1	5-15	1-5	<1	10-25	<10	<1	10-25
4E, 18-20	<1	ND	ND	<1	ND	<10	<1	ND
5A, 10-12	<1	ND	ND	<1	ND	<10	<1	ND
5B, 13-15	<1	ND	ND	<1	ND	<10	<1	ND
5C, 18-20	<1	ND	ND	<1	ND	<10	<1	ND
5D, 23-25	<1	ND	ND	<1	ND	<10	<1	ND
5E, 28-30	<1	ND	ND	<1	ND	<10	<1	ND

Source: USAEHA, 1984.

[a] Values are given to two significant figures. The table lists only those VOCs for which at least one detectable value was measured. NA indicates not analyzed and ND indicates not detected.

[b] See Figure 2-10 for borehole locations.

All soil samples were collected in 1984.

µg/kg - micrograms per kilogram

TABLE 2-2

SUMMARY OF pH AND TOTAL CONCENTRATIONS OF METALS IN SOILS IN THE DRMO TRENCH AREA (μg/kg)[a]

Borehole and Sample[b] Designation	Sample Depth (ft)	Arsenic	Barium	Cadmium	Chromium	Copper	Lead	Mercury	Silver	pH
1A	0-2	<4.0	290	<4.0	9.9	34	56	<0.08	<9.9	7.9
1B	3-5	<3.4	<100	<3.4	<8.5	22	<34	<0.07	<8.5	9.0
1C	8-10	<3.1	<92	<3.1	<7.7	7.7	<31	<0.06	<7.7	8.7
1D	13-15	<3.4	<100	<3.4	<8.5	<8.5	<34	<0.07	<8.5	7.2
1E	18-20	<3.8	<110	<3.8	<9.5	<9.5	<38	<0.08	<9.5	7.8
2A	0-2	<3.4	100	<3.4	<8.4	41	91	<0.07	<8.4	8.3
2B	3-5	<3.5	110	<3.5	13	18	<35	<0.07	<8.7	8.4
2C	8-10	<3.8	<110	<4.0	<9.5	<9.5	<38	<0.08	<9.5	8.1
2D	13-15	<4.0	<120	<4.0	10	<10	<40	<0.07	<10	8.9
2E	18-20	<3.4	<100	<3.4	12	<8.5	<34	<0.08	<8.5	8.3
2F	28-30	<3.9	180	<3.9	10	<10	<39	<0.08	<9.7	7.6
2G	38-40	<4.1	<120	<4.0	<10	<10	<41	<0.08	<10	6.6
3A	0-2	<4.0	130	<5.4	18	11	63	<0.08	<10	8.1
3B	3-5	<3.0	<120	<4.1	19	11	<41	<0.08	<10	8.1
3C	8-10	<3.0	94	<3.1	<7.8	<7.8	<31	<0.06	<7.8	8.4
3D	13-15	<3.0	140	<3.4	9.9	15	<34	<0.07	<8.6	8.3
3E	18-20	<3.0	<89	<3.0	<7.5	<7.5	<30	<0.06	<7.5	7.9
4A	0-2	<3.7	130	7.4	56	16	<37	<0.07	<9.2	8.4
4B	3-5	<3.0	100	5.0	29	15	47	<0.06	<7.8	6.8
4C	8-10	<4.0	<120	<4.1	13	12	54	<0.08	<10	8.9
4D	13-15	<4.0	<110	<3.6	9.4	9.4	<36	<0.07	<9.0	7.8
4E	18-20	<4.0	<110	<3.7	<9.4	<9.4	<37	<0.07	<9.4	8.2
5A	10-12	<3.0	96	5.6	<7.7	64	834	<0.06	<7.7	8.7
5B	13-15	<4.0	120	<3.5	<88	23	120	<0.07	<8.8	8.5
5C	18-20	<4.0	<120	<4.1	<10	<10	<41	<0.08	<10	8.4
5D	23-25	<3.0	<100	<3.4	<8.5	<8.5	<34	<0.07	<8.5	8.4
5E	28-30	<4.0	<120	<3.9	<9.7	<9.7	<39	<0.08	<9.7	8.5

Source: USAEHA, 1985.

[a] Values are given to two significant figures. Samples were also analyzed for selenium; none was detected at a detection limit of 2 ppm.

[b] See Figure 2-10 for borehole locations.

All soil samples were collected in 1984.

μg/kg - micrograms per kilogram

TABLE 2-3

SUMMARY OF CONCENTRATIONS OF BNAs AT VARIOUS DEPTHS IN BORING 2 IN THE DRMO TRENCH AREA

		Concentrations in µg/g								
Sample[a]	Sample Depth (ft)	p,p'-DDT	o,p-DDT	Dimethyl Naphthalenes	Methyl Naphthalene	Naphthalene	1,2,4-Trichloro-benzene	Trimethyl and Methyl Ethyl Benzenes	Hexane Dioic Acid, Dioctyl Ester	C_{10} to C_{16} Hydrocarbons
2A	0-2	12	nd	30-60	30-60	15	16	200-500	30-50	150-300
2B	3-5	5-10	5-30	100-300	100-200	30	30	1,000-3,000	50-150	1,000-3,000
2C	8-10	nd	nd	30-60	30-60	10	10	150-400	nd	300-600
2D	13-15	16	5-30	70-150	70-150	40	40	500-1,000	50-150	2,000-4,000
2E	18-20	nd	nd	nd	nd	nd	nd	nd	nd	50-200
2F	28-30	nd	nd	nd	1-3	nd	nd	nd	nd	1-3
2G	38-40	nd	nd	nd	nd	nd	nd	nd	nd	1-3

Source: USAEHA, 1985.
[a] See Figure 2-2 for borehole location.
All soil samples were collected in 1984.
nd - Not detected.
µg/g - micrograms per gram

which at least one soil sample contained detectable concentrations (USAEHA, 1984). The highest VOC concentrations were generally detected within the upper 10 feet of the soil column beneath the open trench.

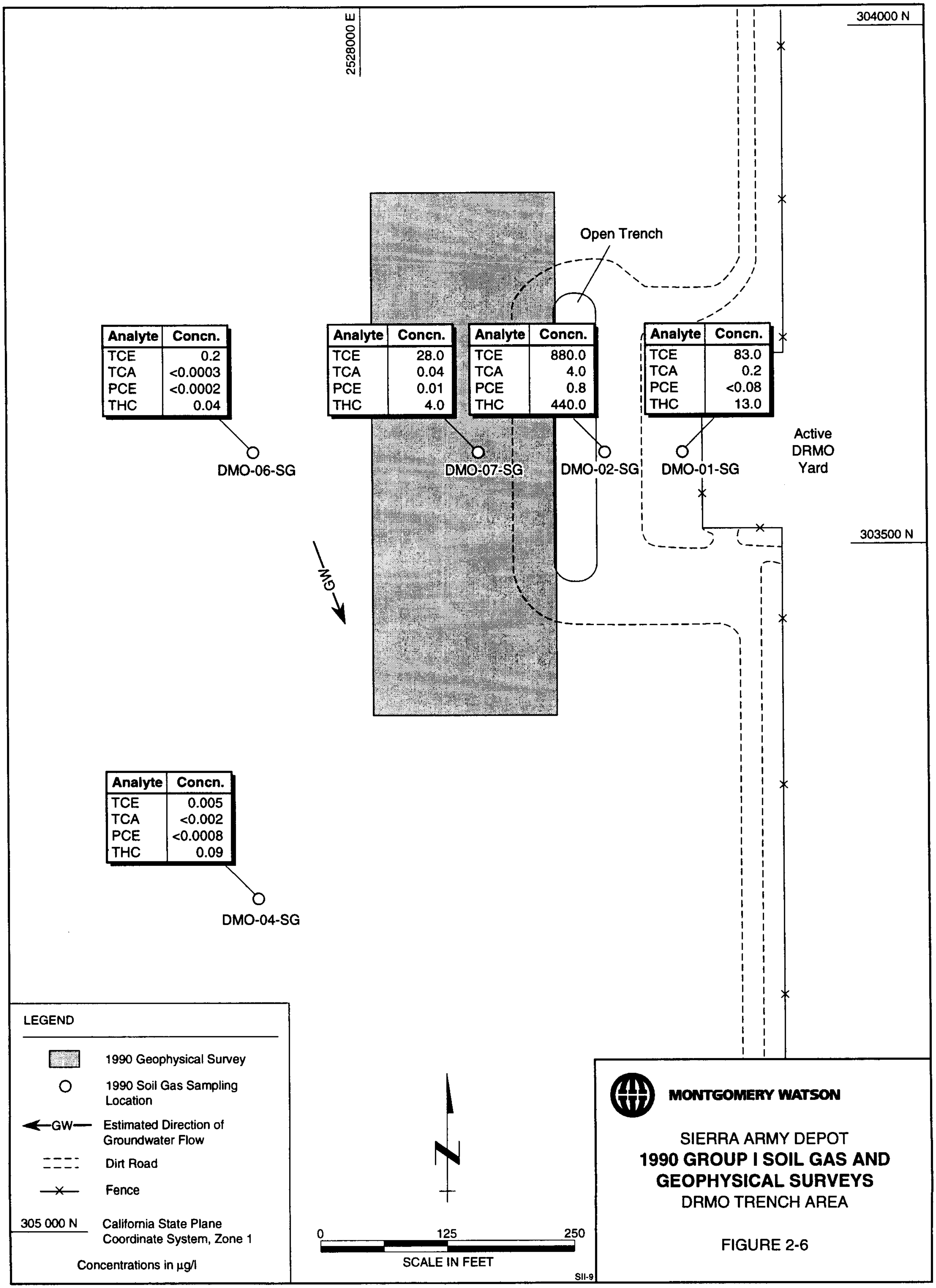
Maximum concentrations of 2,500 micrograms per gram (μg/g) and 2,000 μg/g of 1,2-dichlorobenzene were detected in the 3- to 5-foot sample in Borings 2 and 3, respectively. Maximum concentrations of 710 μg/g of trichloroethene (TCE) and 1,000 to 3,000 μg/g of trimethyl and ethyl methyl benzenes were detected in Boring 3 in the 3- to 5-foot sample. Contrary to VOC sample-handling protocol, the samples were not refrigerated until they were received at the USAEHA laboratories in Maryland (USAEHA, 1984). Therefore, the reported VOC concentrations are believed to underestimate their true values (Benioff, et al., 1988).

Chromium, copper, and lead were detected in the upper 6 feet of the soil column beneath the open trench at concentrations exceeding those detected in the "background" boring (Boring 5) (Table 2-2). Arsenic, barium, cadmium, silver, mercury, and selenium concentrations were similar in each sample collected and were close to the detection limit, indicating that these metals are at natural background concentrations and are not contaminants (Benioff, et al., 1988). Elevated concentrations of lead and copper were detected in Boring 5, located outside the open trench. The source of the lead and copper is unknown (Benioff, et al., 1988). USEPA Extraction Procedure (EP) toxicity testing of soil samples did not detect extractable metals (Benioff, et al., 1988). The detection limits were set at 10 percent of the limits presented in Title 40 of Code Federal Regulations, Part 261-Identification and Listing of Hazardous Waste (40 CFR 261). Therefore, soil in the DRMO open trench were not considered EP toxic according to USEPA test methods (Benioff, et al., 1988).

BNA analyses of Boring 2 samples indicated that isomers of the insecticide dichlorodiphenyltrichloroethane (DDT) (up to 30 μg/g), naphthalenes (up to 300 μg/g), and several other BNA compounds were present to depths of 13 to 15 feet below the bottom of the trench (Table 2-3). The only BNAs found at depths of 18 feet or more were the C10 to C16 aliphatics and small amounts of methyl naphthalene (Benioff, et al., 1988). The deepest sample in Boring 2 was collected at a depth of 38 to 40 feet below the trench bottom and contained 1 to 3 μg/g C10 to C16 aliphatic hydrocarbons.

2.5.1.2 1990 Group I Remedial Investigation. Activities for the 1990 Group I RI included: a limited soil gas survey in the vicinity of the open trench (Figure 2-6); a remote sensing geophysics survey to attempt to locate the suspected buried trench (Figure 2-6); excavation of seven test pits to confirm geophysical anomalies (Figure 2-7), and the drilling and sampling of eight soil borings from ground surface to the top of the water table.

Six of the soil borings were drilled up to 100 feet away from the open trench to determine the horizontal extent of soil contamination. The remaining two soil borings were drilled immediately adjacent to the trench at an angle to try to determine the contamination directly below the open trench. VOCs, pesticides, SVOCs, and selected metals were detected in subsurface soil at the DRMO open trench (Figures 2-8 to 2-11). VOCs detected in soil include benzene, chlorobenzene, methylene chloride, toluene, and TCE. The SVOCs detected include 1,2-dichlorobenzene, phenol, and the following pesticides: aldrin, DDT, DDD, DDE, and

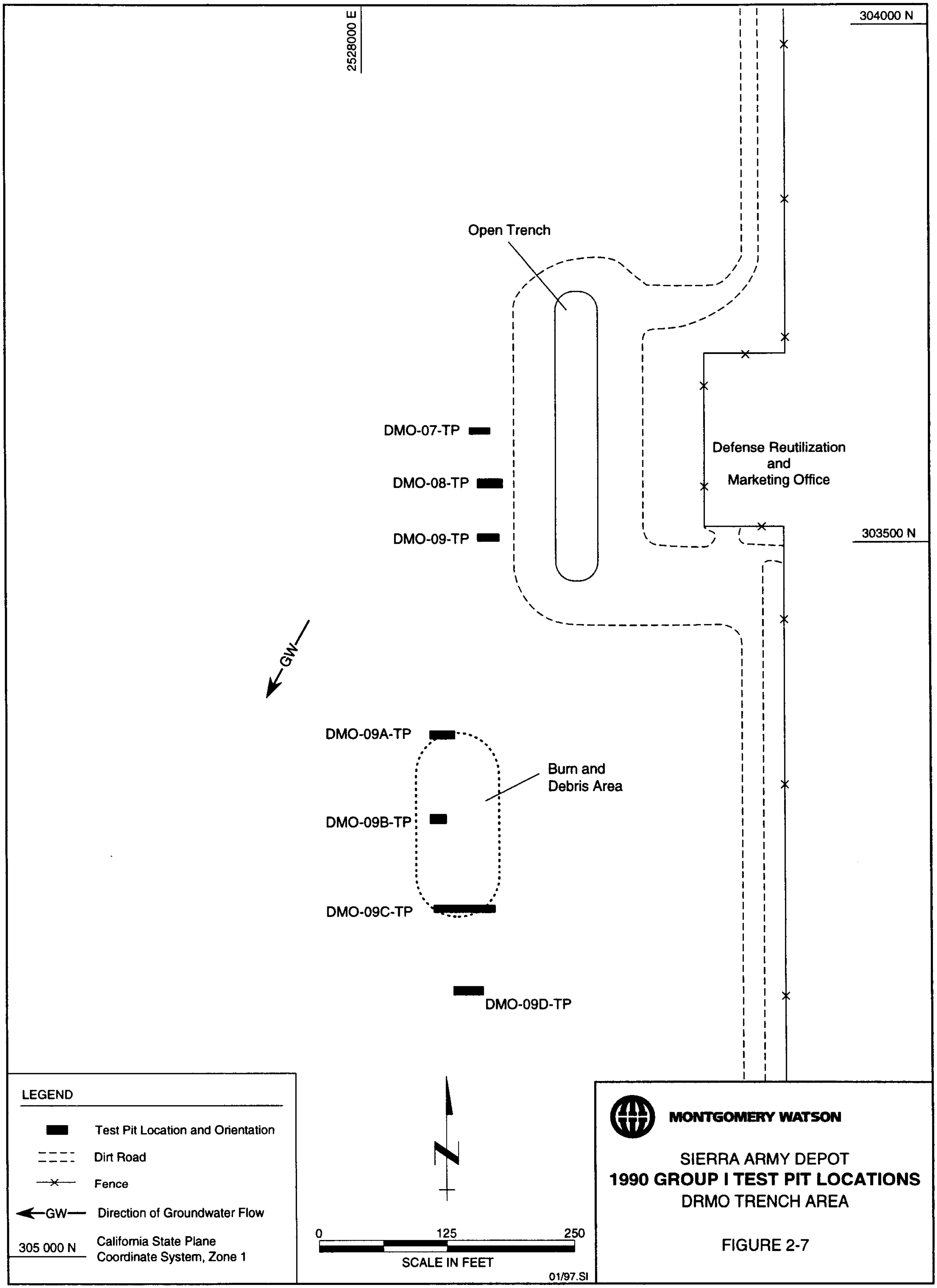


SIERRA ARMY DEPOT

1990 GROUP I SOIL GAS AND GEOPHYSICAL SURVEYS

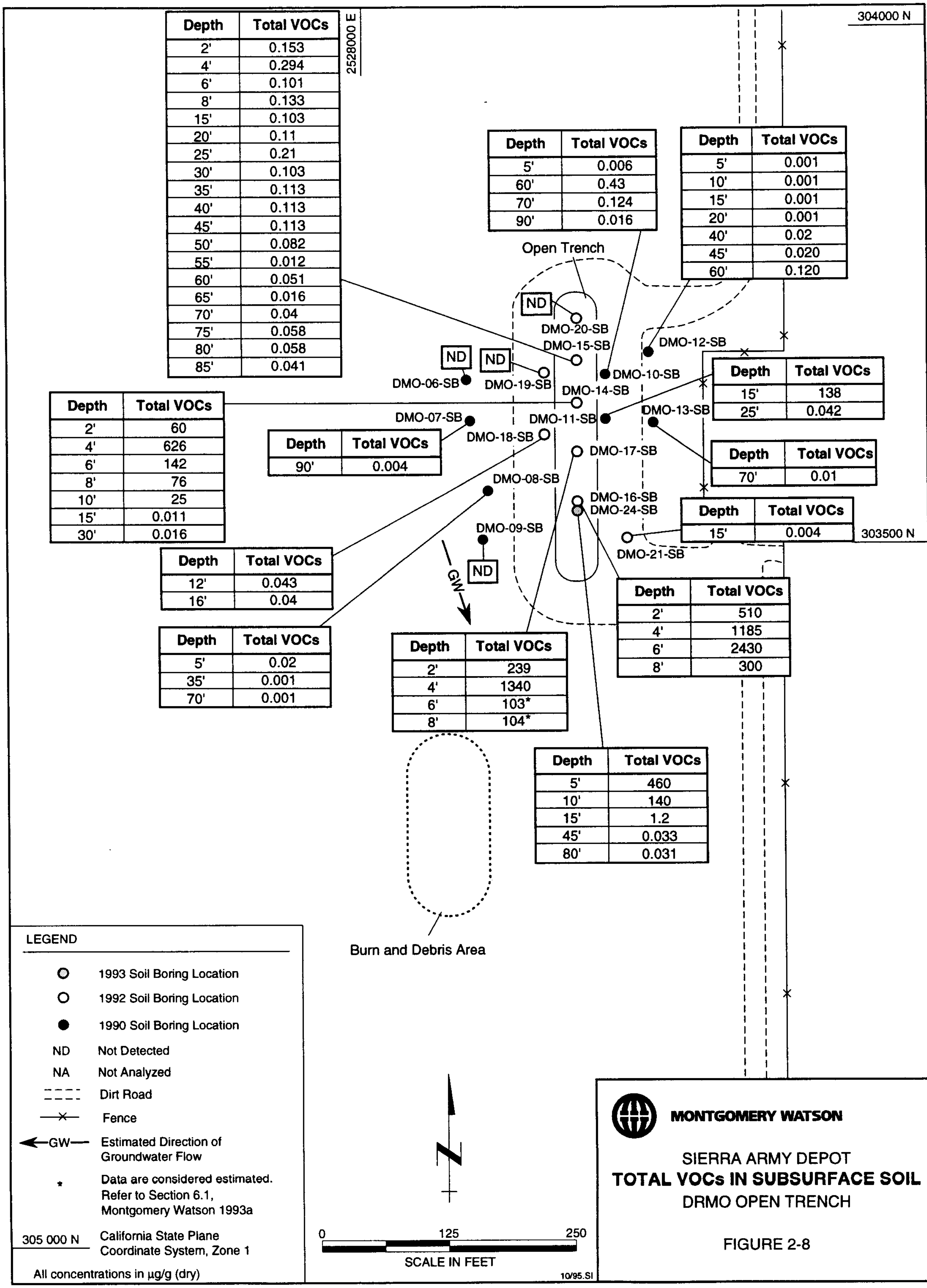
DRMO TRENCH AREA

FIGURE 2-6



SIERRA ARMY DEPOT
1990 GROUP I TEST PIT LOCATIONS
DRMO TRENCH AREA

FIGURE 2-7



Depth	Total VOCs
2'	0.153
4'	0.294
6'	0.101
8'	0.133
15'	0.103
20'	0.11
25'	0.21
30'	0.103
35'	0.113
40'	0.113
45'	0.113
50'	0.082
55'	0.012
60'	0.051
65'	0.016
70'	0.04
75'	0.058
80'	0.058
85'	0.041

Depth	Total VOCs
5'	0.006
60'	0.43
70'	0.124
90'	0.016

Depth	Total VOCs
5'	0.001
10'	0.001
15'	0.001
20'	0.001
40'	0.02
45'	0.020
60'	0.120

Depth	Total VOCs
15'	138
25'	0.042

Depth	Total VOCs
2'	60
4'	626
6'	142
8'	76
10'	25
15'	0.011
30'	0.016

Depth	Total VOCs
90'	0.004

Depth	Total VOCs
70'	0.01

Depth	Total VOCs
15'	0.004

Depth	Total VOCs
12'	0.043
16'	0.04

Depth	Total VOCs
2'	510
4'	1185
6'	2430
8'	300

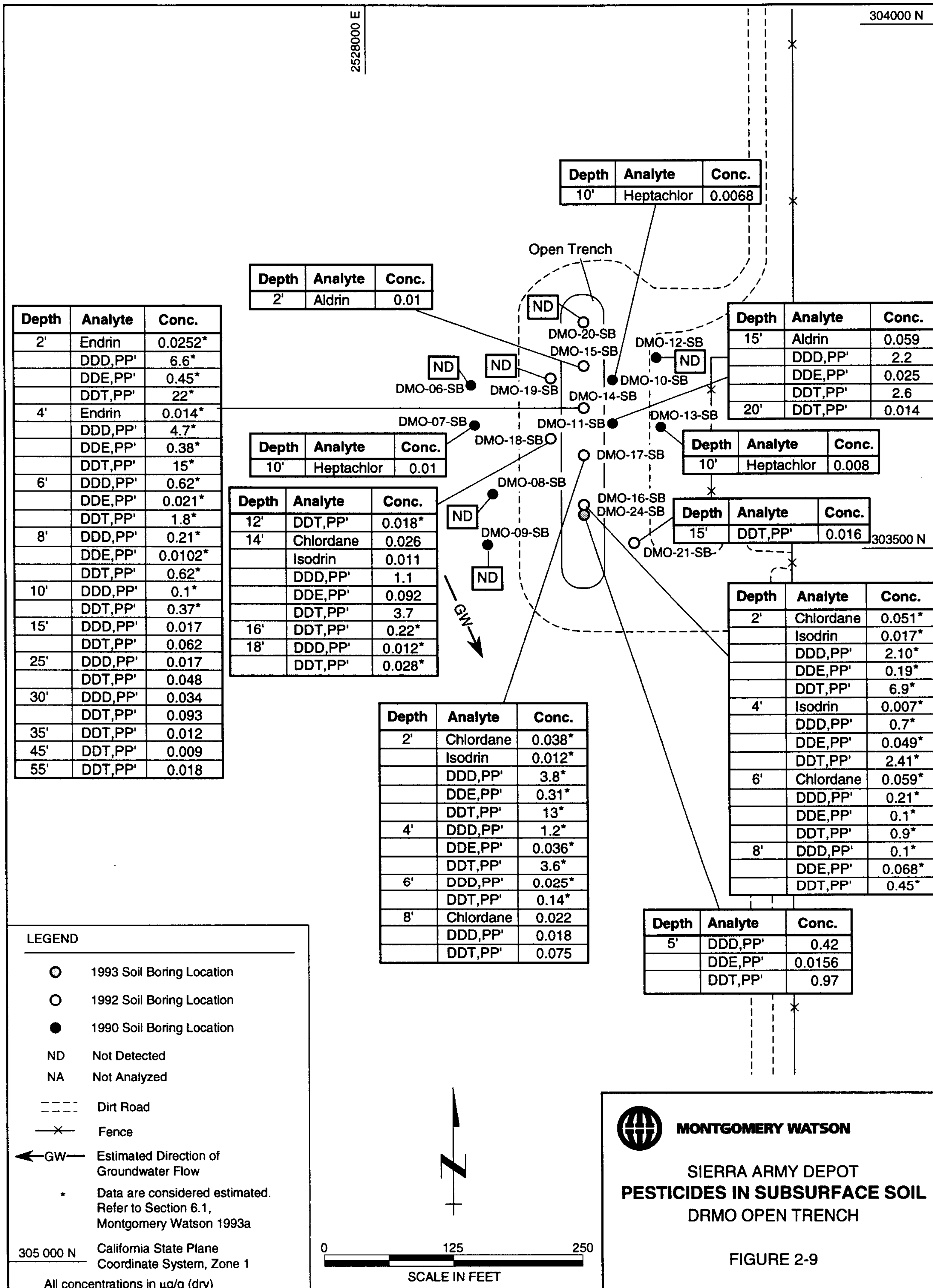
Depth	Total VOCs
5'	0.02
35'	0.001
70'	0.001

Depth	Total VOCs
2'	239
4'	1340
6'	103*
8'	104*

Depth	Total VOCs
5'	460
10'	140
15'	1.2
45'	0.033
80'	0.031

SIERRA ARMY DEPOT
TOTAL VOCs IN SUBSURFACE SOIL
DRMO OPEN TRENCH

FIGURE 2-8



Depth	Analyte	Conc.
10'	Heptachlor	0.0068

Depth	Analyte	Conc.
2'	Aldrin	0.01

Depth	Analyte	Conc.
2'	Endrin	0.0252*
	DDD,PP'	6.6*
	DDE,PP'	0.45*
	DDT,PP'	22*
4'	Endrin	0.014*
	DDD,PP'	4.7*
	DDE,PP'	0.38*
	DDT,PP'	15*
6'	DDD,PP'	0.62*
	DDE,PP'	0.021*
	DDT,PP'	1.8*
8'	DDD,PP'	0.21*
	DDE,PP'	0.0102*
	DDT,PP'	0.62*
10'	DDD,PP'	0.1*
	DDT,PP'	0.37*
15'	DDD,PP'	0.017
	DDT,PP'	0.062
25'	DDD,PP'	0.017
	DDT,PP'	0.048
30'	DDD,PP'	0.034
	DDT,PP'	0.093
35'	DDT,PP'	0.012
45'	DDT,PP'	0.009
55'	DDT,PP'	0.018

Depth	Analyte	Conc.
15'	Aldrin	0.059
	DDD,PP'	2.2
	DDE,PP'	0.025
	DDT,PP'	2.6
20'	DDT,PP'	0.014

Depth	Analyte	Conc.
10'	Heptachlor	0.01

Depth	Analyte	Conc.
10'	Heptachlor	0.008

Depth	Analyte	Conc.
12'	DDT,PP'	0.018*
14'	Chlordane	0.026
	Isodrin	0.011
	DDD,PP'	1.1
	DDE,PP'	0.092
	DDT,PP'	3.7
16'	DDT,PP'	0.22*
18'	DDD,PP'	0.012*
	DDT,PP'	0.028*

Depth	Analyte	Conc.
15'	DDT,PP'	0.016

Depth	Analyte	Conc.
2'	Chlordane	0.051*
	Isodrin	0.017*
	DDD,PP'	2.10*
	DDE,PP'	0.19*
	DDT,PP'	6.9*
4'	Isodrin	0.007*
	DDD,PP'	0.7*
	DDE,PP'	0.049*
	DDT,PP'	2.41*
6'	Chlordane	0.059*
	DDD,PP'	0.21*
	DDE,PP'	0.1*
	DDT,PP'	0.9*
8'	DDD,PP'	0.1*
	DDE,PP'	0.068*
	DDT,PP'	0.45*

Depth	Analyte	Conc.
2'	Chlordane	0.038*
	Isodrin	0.012*
	DDD,PP'	3.8*
	DDE,PP'	0.31*
	DDT,PP'	13*
4'	DDD,PP'	1.2*
	DDE,PP'	0.036*
	DDT,PP'	3.6*
6'	DDD,PP'	0.025*
	DDT,PP'	0.14*
8'	Chlordane	0.022
	DDD,PP'	0.018
	DDT,PP'	0.075

Depth	Analyte	Conc.
5'	DDD,PP'	0.42
	DDE,PP'	0.0156
	DDT,PP'	0.97

LEGEND

◎	1993 Soil Boring Location
○	1992 Soil Boring Location
●	1990 Soil Boring Location
ND	Not Detected
NA	Not Analyzed
- - - -	Dirt Road
—×—	Fence
←GW—	Estimated Direction of Groundwater Flow
*	Data are considered estimated. Refer to Section 6.1, Montgomery Watson 1993a
305 000 N	California State Plane Coordinate System, Zone 1

All concentrations in µg/g (dry)

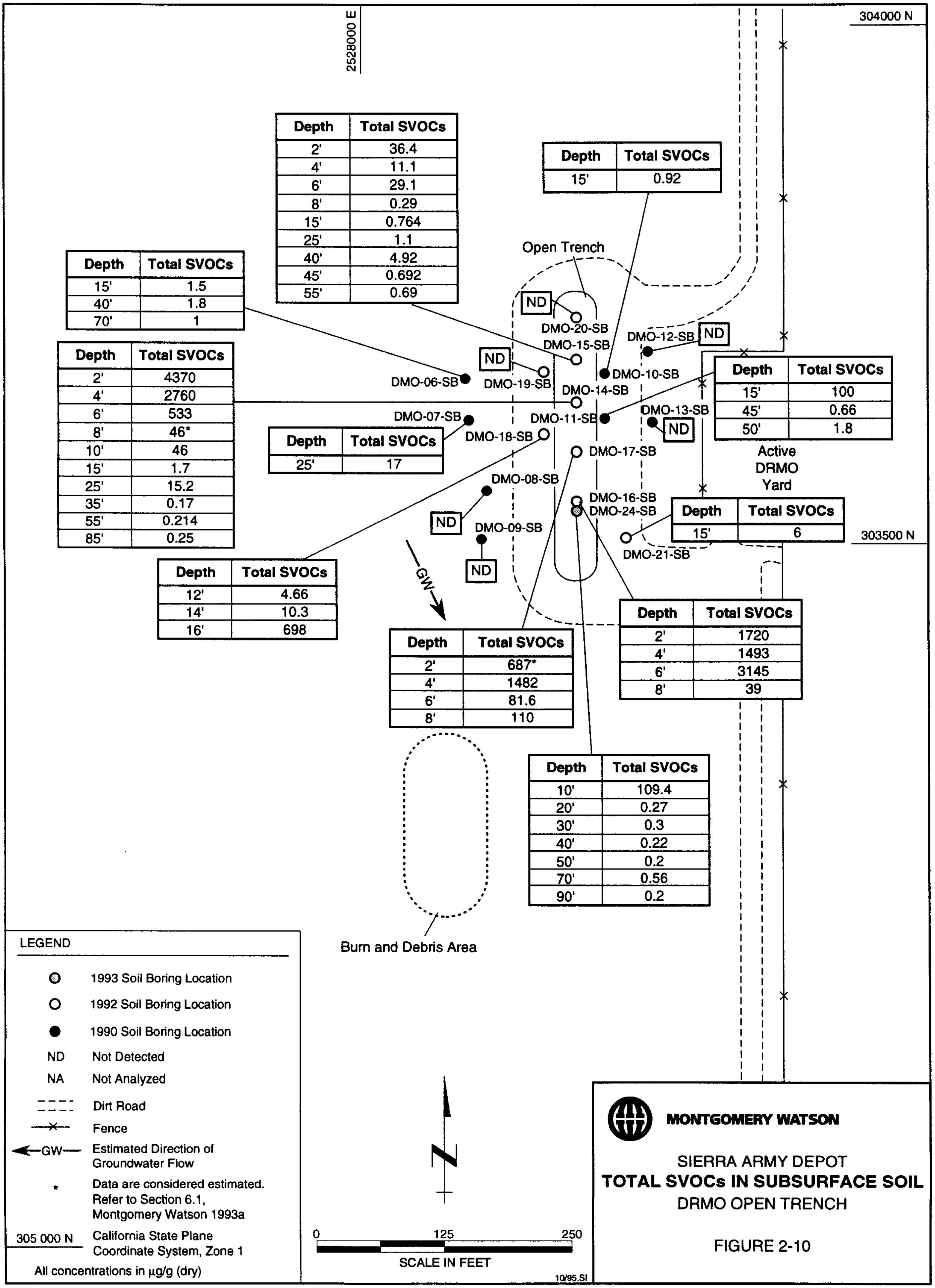
MONTGOMERY WATSON

SIERRA ARMY DEPOT

PESTICIDES IN SUBSURFACE SOIL

DRMO OPEN TRENCH

FIGURE 2-9



Depth	Total SVOCs
2'	36.4
4'	11.1
6'	29.1
8'	0.29
15'	0.764
25'	1.1
40'	4.92
45'	0.692
55'	0.69

Depth	Total SVOCs
15'	0.92

Depth	Total SVOCs
15'	1.5
40'	1.8
70'	1

Depth	Total SVOCs
2'	4370
4'	2760
6'	533
8'	46*
10'	46
15'	1.7
25'	15.2
35'	0.17
55'	0.214
85'	0.25

Depth	Total SVOCs
15'	100
45'	0.66
50'	1.8

Depth	Total SVOCs
25'	17

Depth	Total SVOCs
15'	6

Depth	Total SVOCs
12'	4.66
14'	10.3
16'	698

Depth	Total SVOCs
2'	1720
4'	1493
6'	3145
8'	39

Depth	Total SVOCs
2'	687*
4'	1482
6'	81.6
8'	110

Depth	Total SVOCs
10'	109.4
20'	0.27
30'	0.3
40'	0.22
50'	0.2
70'	0.56
90'	0.2

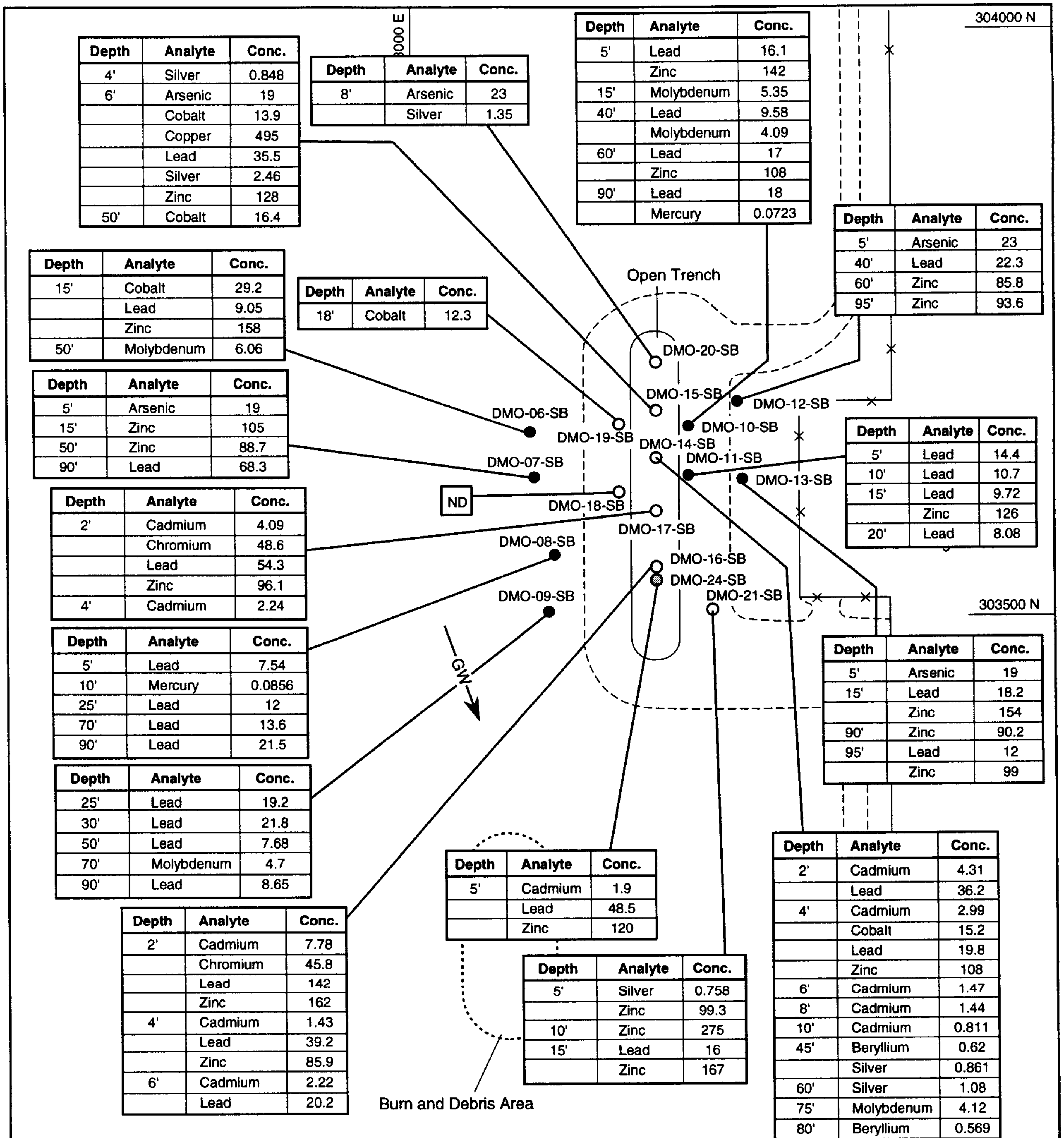
MONTGOMERY WATSON

SIERRA ARMY DEPOT

TOTAL SVOCs IN SUBSURFACE SOIL

DRMO OPEN TRENCH

FIGURE 2-10



Depth	Analyte	Conc.
4'	Silver	0.848
6'	Arsenic	19
	Cobalt	13.9
	Copper	495
	Lead	35.5
	Silver	2.46
	Zinc	128
50'	Cobalt	16.4

Depth	Analyte	Conc.
8'	Arsenic	23
	Silver	1.35

Depth	Analyte	Conc.
5'	Lead	16.1
	Zinc	142
15'	Molybdenum	5.35
40'	Lead	9.58
	Molybdenum	4.09
60'	Lead	17
	Zinc	108
90'	Lead	18
	Mercury	0.0723

Depth	Analyte	Conc.
5'	Arsenic	23
40'	Lead	22.3
60'	Zinc	85.8
95'	Zinc	93.6

Depth	Analyte	Conc.
15'	Cobalt	29.2
	Lead	9.05
	Zinc	158
50'	Molybdenum	6.06

Depth	Analyte	Conc.
18'	Cobalt	12.3

Depth	Analyte	Conc.
5'	Arsenic	19
15'	Zinc	105
50'	Zinc	88.7
90'	Lead	68.3

Depth	Analyte	Conc.
5'	Lead	14.4
10'	Lead	10.7
15'	Lead	9.72
	Zinc	126
20'	Lead	8.08

Depth	Analyte	Conc.
2'	Cadmium	4.09
	Chromium	48.6
	Lead	54.3
	Zinc	96.1
4'	Cadmium	2.24

Depth	Analyte	Conc.
5'	Lead	7.54
10'	Mercury	0.0856
25'	Lead	12
70'	Lead	13.6
90'	Lead	21.5

Depth	Analyte	Conc.
5'	Arsenic	19
15'	Lead	18.2
	Zinc	154
90'	Zinc	90.2
95'	Lead	12
	Zinc	99

Depth	Analyte	Conc.
25'	Lead	19.2
30'	Lead	21.8
50'	Lead	7.68
70'	Molybdenum	4.7
90'	Lead	8.65

Depth	Analyte	Conc.
5'	Cadmium	1.9
	Lead	48.5
	Zinc	120

Depth	Analyte	Conc.
2'	Cadmium	4.31
	Lead	36.2
4'	Cadmium	2.99
	Cobalt	15.2
	Lead	19.8
	Zinc	108
6'	Cadmium	1.47
8'	Cadmium	1.44
10'	Cadmium	0.811
45'	Beryllium	0.62
	Silver	0.861
60'	Silver	1.08
75'	Molybdenum	4.12
80'	Beryllium	0.569
85'	Cobalt	12.2
	Silver	0.958

Depth	Analyte	Conc.
2'	Cadmium	7.78
	Chromium	45.8
	Lead	142
	Zinc	162
4'	Cadmium	1.43
	Lead	39.2
	Zinc	85.9
6'	Cadmium	2.22
	Lead	20.2

Depth	Analyte	Conc.
5'	Silver	0.758
	Zinc	99.3
10'	Zinc	275
15'	Lead	16
	Zinc	167

LEGEND

- 1993 Soil Boring Location
- 1992 Soil Boring Location
- 1990 Soil Boring Location
- ND — Not Detected Above Maximum Background Concentration
- Dirt Road
- Fence
- GW — Estimated Direction of Groundwater Flow
- 305 000 N — California State Plane Coordinate System, Zone 1

All concentrations in μg/g (dry)

0 125 250

SCALE IN FEET

11/95.SI

MONTGOMERY WATSON

SIERRA ARMY DEPOT

SELECTED METALS CONCENTRATIONS ABOVE BACKGROUND IN SUBSURFACE SOIL

DRMO OPEN TRENCH

FIGURE 2-11

heptachlor. The soil contamination was found to be generally limited to the area directly below the open trench. Analytical results from two of the soil borings indicate that downward migration of TCE has occurred at the site (Figure 2-12). The range of concentrations, total number of samples, and number of samples where each analyte was detected at the DRMO Open Trench are presented in Table 2-4.

A burn and debris area, approximately 55 feet wide by 175 feet long, was discovered about 120 feet southwest of the open trench, but was not sampled. The area consists of loose sand to silty sand containing gravel, cobbles, metal and glass debris, and some small caliber shell casings. The soil within the Burn and Debris Area is darker in color than the surrounding native surface soil and contains some slag or cinders. The surface of the Burn and Debris Area is elevated approximately 4 to 12 inches above the surrounding area indicating that the material may have been brought to the site and spread. Samples were not collected from the Burn and Debris Area during the 1990 Group I RI.

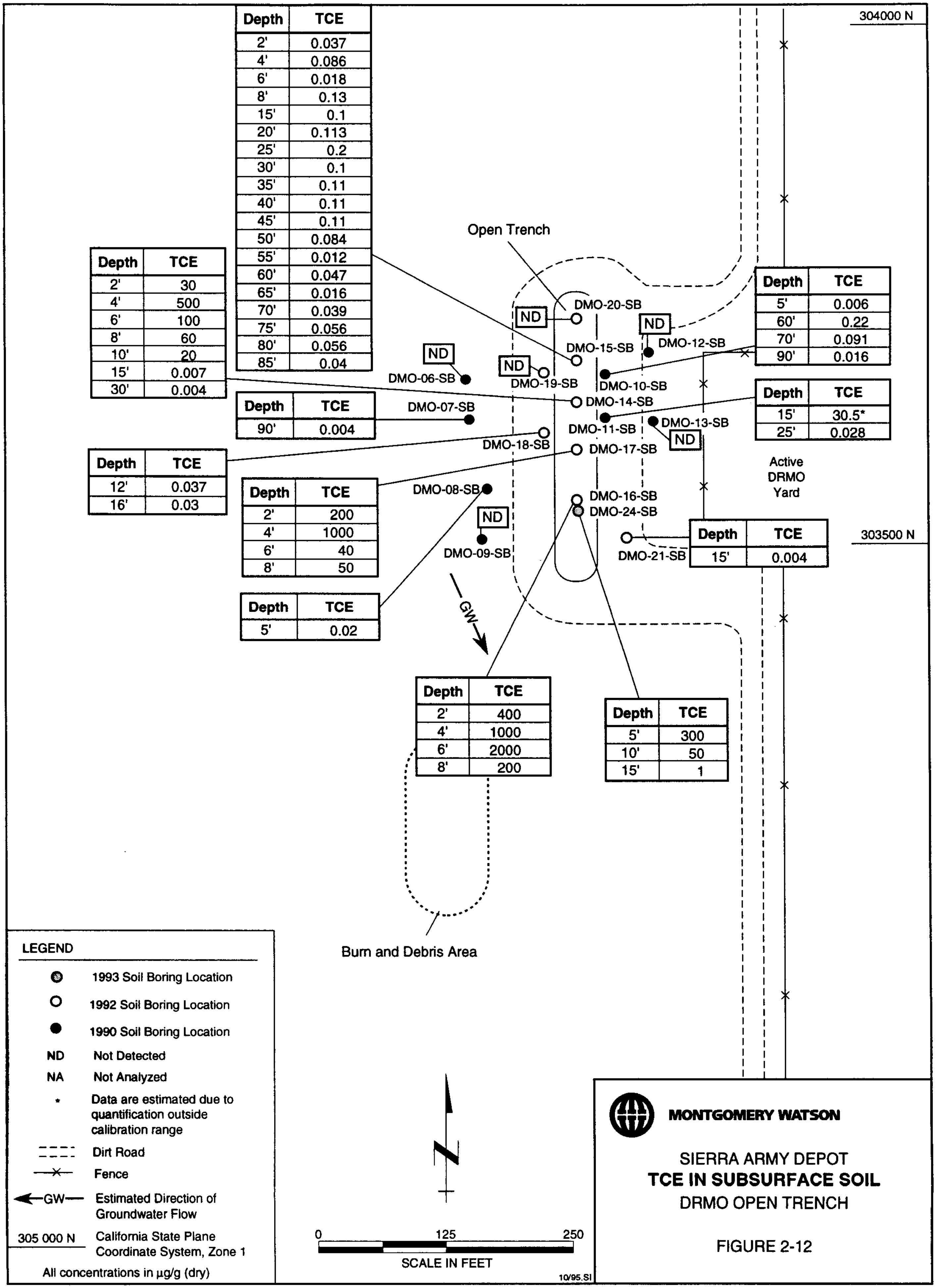
2.5.1.3 1992 Group I Follow-Up Remedial Investigation. A soil gas survey conducted during the 1992 Group I Follow-Up investigation revealed high levels of VOCs (greater than 100 µg/L) in the soil gas in the vicinity of the open trench (Figure 2-13). Soil gas VOC concentrations decrease with distance in all directions from the open trench, indicating that the trench is a source of VOCs at the site.

Soil borings drilled in and adjacent to the open trench indicated the presence of SVOC and VOC contamination in the soil from ground surface to the soil/groundwater interface beneath portions of the open trench (Figures 2-8 and 2-10). The highest concentrations of contaminants were detected in the southern end of the open trench. SESOIL vadose zone modeling using soil boring data suggests that downward migration of SVOCs and VOCs to the water table is occurring beneath the open trench. Pesticides and metals were also detected in soil beneath the open trench (Figures 2-9 and 2-11). The range of concentrations, total number of samples, and number of samples where each analyte was detected at the DRMO Open Trench are presented in Table 2-4.

Surface and near surface soil samples collected within the Burn and Debris Area contained high levels of metals and the PCB-1260 (Figures 2-14 to 2-17). The range of concentrations, total number of samples, and number of samples where each analyte was detected at the Burn and Debris Area are presented in Table 2-5.

2.5.1.4 1993 Group I and II Follow-Up Remedial Investigation. A soil gas survey conducted within the DRMO Active Yard to identify and delineate the presence of VOCs in the unsaturated zone which may be contributing to TCE in groundwater below the active yard. The TCE detected in soil gas is mostly present at low levels (less than 10 µg/L) but there are higher levels (up to 3,000 µg/L) present in localized areas (Figure 2-13). A geophysical survey was also conducted within the DRMO Active Yard to locate possible sources for VOCs in groundwater beneath the active yard. The ground penetrating radar (GPR) profile showed several large areas of continuous reflections typical of buried debris.

Four test pits were excavated within the DRMO Active Yard to investigate soil gas and geophysical anomalies. Native soil was encountered between ground surface and 1 foot bgs in



304000 N
303500 N
Depth TCE
2' 0.037
4' 0.086
6' 0.018
8' 0.13
15' 0.1
20' 0.113
25' 0.2
30' 0.1
35' 0.11
40' 0.11
45' 0.11
50' 0.084
55' 0.012
60' 0.047
65' 0.016
70' 0.039
75' 0.056
80' 0.056
85' 0.04
Depth TCE
2' 30
4' 500
6' 100
8' 60
10' 20
15' 0.007
30' 0.004
Depth TCE
90' 0.004
Depth TCE
12' 0.037
16' 0.03
Depth TCE
2' 200
4' 1000
6' 40
8' 50
Depth TCE
5' 0.02
Depth TCE
5' 0.006
60' 0.22
70' 0.091
90' 0.016
Depth TCE
15' 30.5*
25' 0.028
Depth TCE
15' 0.004
Depth TCE
2' 400
4' 1000
6' 2000
8' 200
Depth TCE
5' 300
10' 50
15' 1
Open Trench
DMO-20-SB
DMO-15-SB
DMO-12-SB
DMO-06-SB
DMO-19-SB
DMO-10-SB
DMO-14-SB
DMO-07-SB
DMO-11-SB
DMO-13-SB
DMO-18-SB
DMO-17-SB
DMO-08-SB
DMO-16-SB
DMO-24-SB
DMO-09-SB
DMO-21-SB
ND
Active DRMO Yard
GW
Burn and Debris Area
LEGEND
1993 Soil Boring Location
1992 Soil Boring Location
1990 Soil Boring Location
ND Not Detected
NA Not Analyzed
* Data are estimated due to quantification outside calibration range
Dirt Road
Fence
GW Estimated Direction of Groundwater Flow
305 000 N California State Plane Coordinate System, Zone 1
All concentrations in µg/g (dry)
0 125 250
SCALE IN FEET
10/95.SI
MONTGOMERY WATSON
SIERRA ARMY DEPOT
TCE IN SUBSURFACE SOIL
DRMO OPEN TRENCH
FIGURE 2-12

TABLE 2-4

SUMMARY OF SURFACE AND SUBSURFACE SOIL ANALYTICAL DATA
DRMO OPEN TRENCH
(Page 1 of 2)

Analyte	Concentration Range (µg/g)	Total Number of Samples	Number of Detects	Number of Detects Greater than Background
TOC				
Total Organic Carbon	nd to 461	6	3	na
Total Organic Content, 444C (ASTM)	0.226 to 1.65	6	6	na
Metals				
Antimony	nd to 29.4	205	2	2
Arsenic	1.06 to 23	205	205	5
Barium	nd to 490	205	193	0
Beryllium	nd to 0.62	205	2	2
Cadmium	nd to 14.6	205	18	18
Calcium	1160 to 4840	15	15	na
Chromium	nd to 91.7	205	65	5
Chromium, hexavalent	nd to 1.23	7	3	na*
Cobalt	nd to 29.2	205	89	6
Copper	nd to 495	205	93	3
Lead	nd to 227	205	37	36
Mercury	nd to 0.0856	205	2	2
Molybdenum	nd to 6.06	205	45	5
Nickel	nd to 17.9	205	80	0
Silver	nd to 2.64	205	13	8
Sodium	382 to 2040	15	15	na
Thallium	nd to 21.7	205	10	0
Vanadium	nd to 120	205	191	0
Zinc	nd to 1660	205	132	26
Pesticides/PCBs				
Aldrin	nd to 0.059	205	2	na
Chlordane	nd to 0.0588	190	6	na
Endrin	nd to 0.0252	205	3	na
Heptachlor	nd to 0.0104	205	4	na
Isodrin	nd to 0.0166	205	5	na
p,p-DDD	nd to 6.6	205	24	na
p,p-DDE	nd to 1.1	205	17	na
p,p-DDT	nd to 22	205	33	na
SVOCs				
1,2,4-Trichlorobenzene	nd to 100	185	30	na
1,2-Dichlorobenzene	nd to 3000	185	39	na
1,3-Dichlorobenzene	nd to 500	185	25	na
1,4-Dichlorobenzene	nd to 700	185	31	na
2,4-Dimethylphenol	nd to 1.4	185	1	na
2-Methylnaphthalene	nd to 100	185	27	na
2-Methylphenol / 2-cresol	nd to 60	185	5	na
4-Methylphenol / 4-Cresol / p-Cresol	nd to 80	185	5	na
Acenaphthene	nd to 3	185	9	na
Anthracene	nd to 0.8	185	4	na
Benzo[a]anthracene	nd to 1	185	3	na
Benzo[a]pyrene	nd to 1	185	1	na
Benzo[b]fluoranthene	nd to 0.5	185	1	na

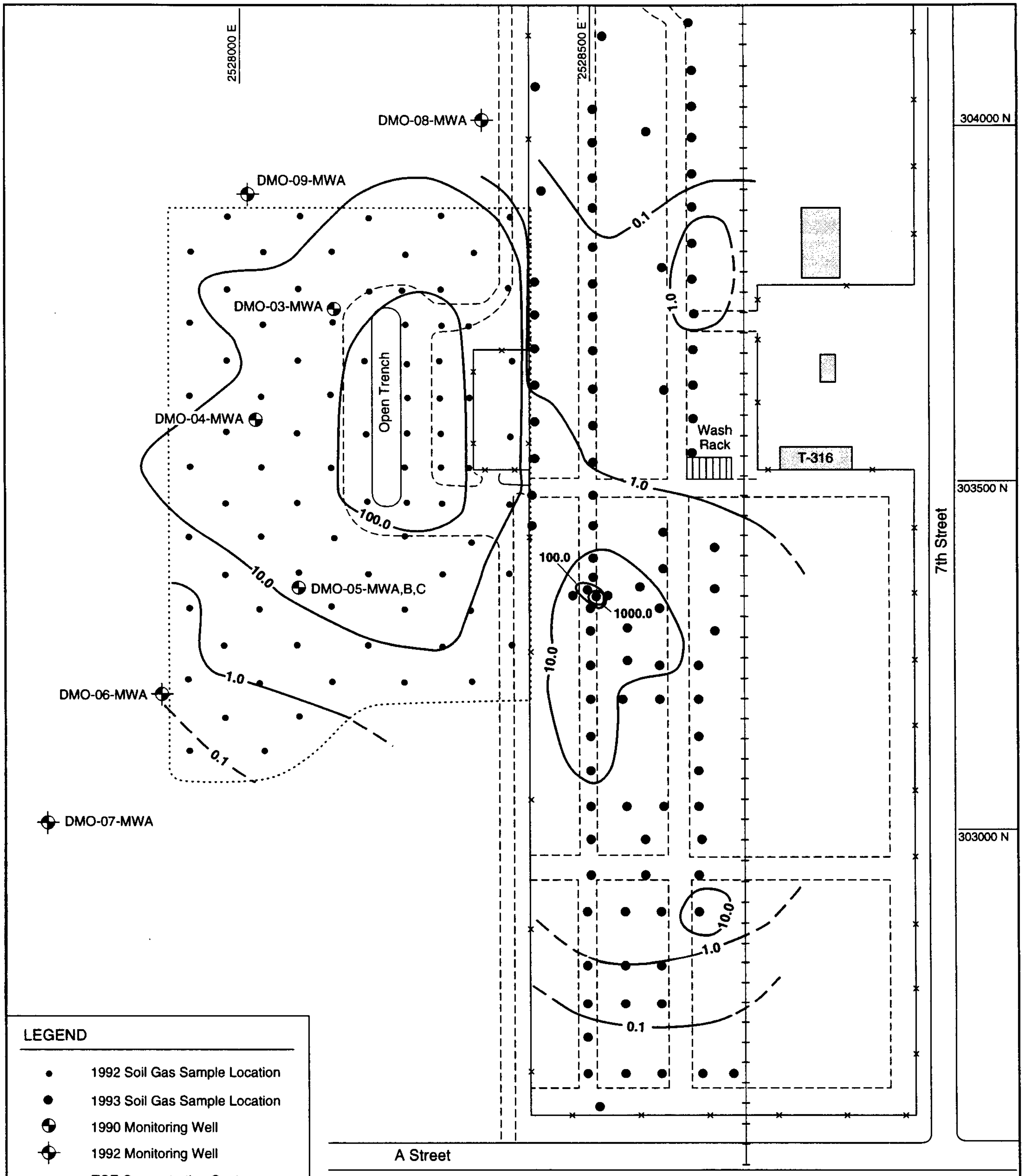
nd-not detected
na-not applicable
na*-background soil samples were not analyzed for hexavalent chromium, therefore the number of detects greater than the background level for hexavalent chromium was not determined.

TABLE 2-4

SUMMARY OF SURFACE AND SUBSURFACE SOIL ANALYTICAL DATA
DRMO OPEN TRENCH
(Page 2 of 2)

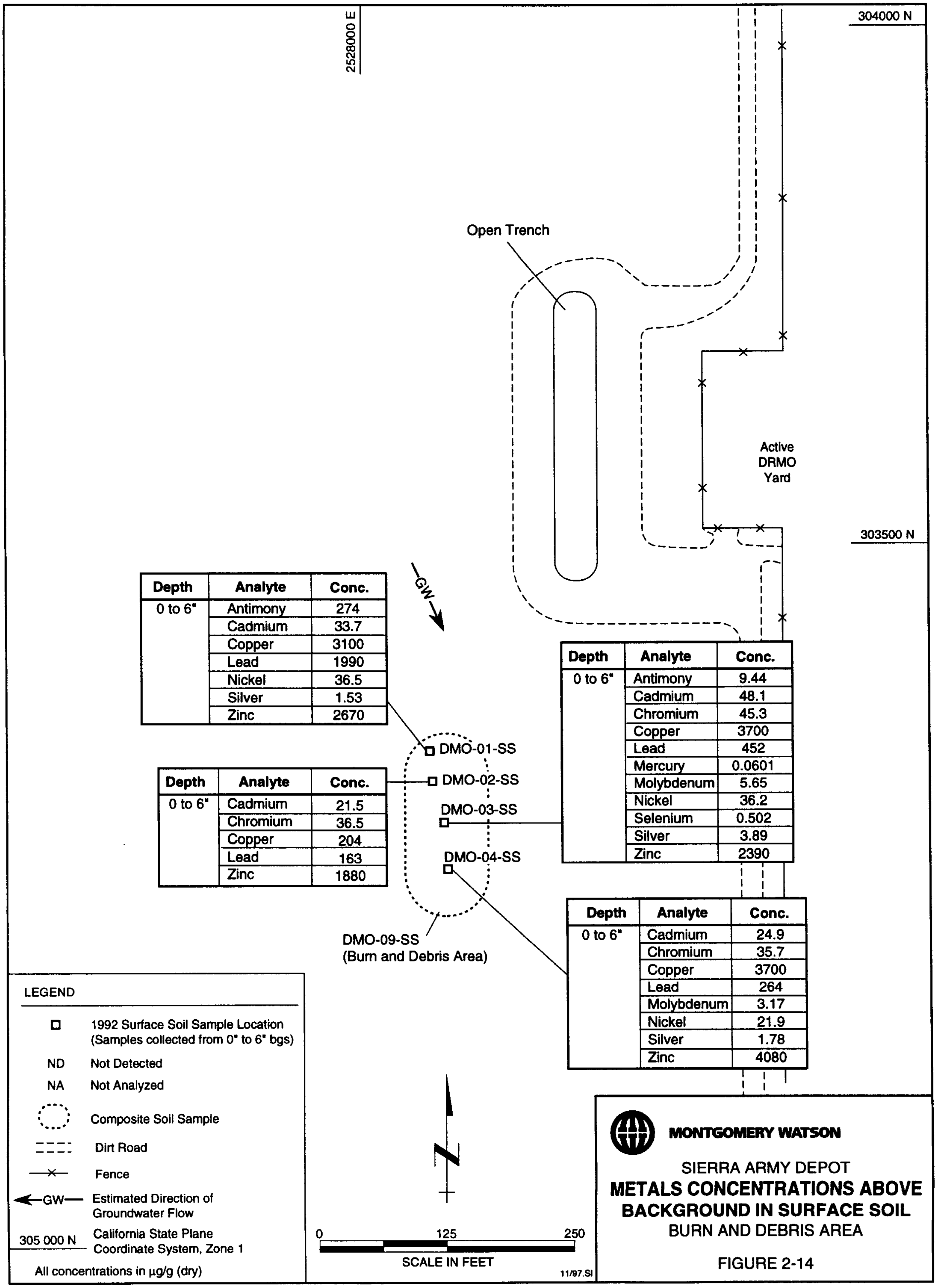
Analyte	Concentration Range (µg/g)	Total Number of Samples	Number of Detects	Number of Detects Greater than Background
SVOCs				
Benzo[g,h,i]perylene	nd to 0.8	185	1	na
Benzo[k]fluoranthene	nd to 0.8	185	1	na
Bis (2-ethylhexyl) phthalate	nd to 17	185	7	na
Butylbenzyl phthalate	nd to 0.32	185	1	na
Chrysene	nd to 0.9	185	2	na
Di-n-butyl phthalate	nd to 0.51	185	8	na
Dibenzofuran	nd to 2	185	7	na
Fluoranthene	nd to 30	185	15	na
Fluorene	nd to 3	185	10	na
Indeno[1,2,3-C,D]pyrene	nd to 0.7	185	1	na
Naphthalene	nd to 30	185	24	na
Phenanthrene	nd to 6	185	26	na
Phenol	nd to 1.8	185	3	na
Pyrene	nd to 4	185	9	na
Oil & Grease				
Oil & Grease	nd to 17000	15	9	na
TPH				
TPH, diesel fraction	nd to 2200	15	4	na
TPH, gas fraction	nd to 1650	15	2	na
TRPH, total recoverable	nd to 1350	15	4	na
VOCS				
1,1,1-Trichloroethane	nd to 1	205	1	na
1,1,2,2-Tetrachloroethane	nd to 1	205	1	na
1,1-Dichloroethene	nd to 0.2	205	1	na
1,2-Dichloroethane	nd to 0.1	205	1	na
1,2-Dichloropropane	nd to 0.05	205	1	na
Acetone	nd to 0.1	205	4	na
Benzene	nd to 1	205	1	na
Chlorobenzene	nd to 100	205	26	na
Chloroform	nd to 0.05	205	1	na
Ethylbenzene	nd to 40	205	16	na
Methylene chloride	nd to 0.6	205	4	na
Tetrachloroethene	nd to 10	205	10	na
Toluene	nd to 200	205	43	na
Trichloroethene	nd to 2000	205	56	na
Xylenes	nd to 100	205	24	na

nd-not detected
na-not applicable



SIERRA ARMY DEPOT
SOIL GAS TCE PLUME
DRMO TRENCH AREA

FIGURE 2-13



DMO-01-SS:

Depth	Analyte	Conc.
0 to 6"	Antimony	274
	Cadmium	33.7
	Copper	3100
	Lead	1990
	Nickel	36.5
	Silver	1.53
	Zinc	2670

DMO-02-SS:

Depth	Analyte	Conc.
0 to 6"	Cadmium	21.5
	Chromium	36.5
	Copper	204
	Lead	163
	Zinc	1880

DMO-03-SS:

Depth	Analyte	Conc.
0 to 6"	Antimony	9.44
	Cadmium	48.1
	Chromium	45.3
	Copper	3700
	Lead	452
	Mercury	0.0601
	Molybdenum	5.65
	Nickel	36.2
	Selenium	0.502
	Silver	3.89
	Zinc	2390

DMO-04-SS:

Depth	Analyte	Conc.
0 to 6"	Cadmium	24.9
	Chromium	35.7
	Copper	3700
	Lead	264
	Molybdenum	3.17
	Nickel	21.9
	Silver	1.78
	Zinc	4080

LEGEND

- ◻ 1992 Surface Soil Sample Location (Samples collected from 0" to 6" bgs)
- ND Not Detected
- NA Not Analyzed
- Composite Soil Sample
- Dirt Road
- Fence
- ←GW— Estimated Direction of Groundwater Flow
- 305 000 N California State Plane Coordinate System, Zone 1

All concentrations in µg/g (dry)

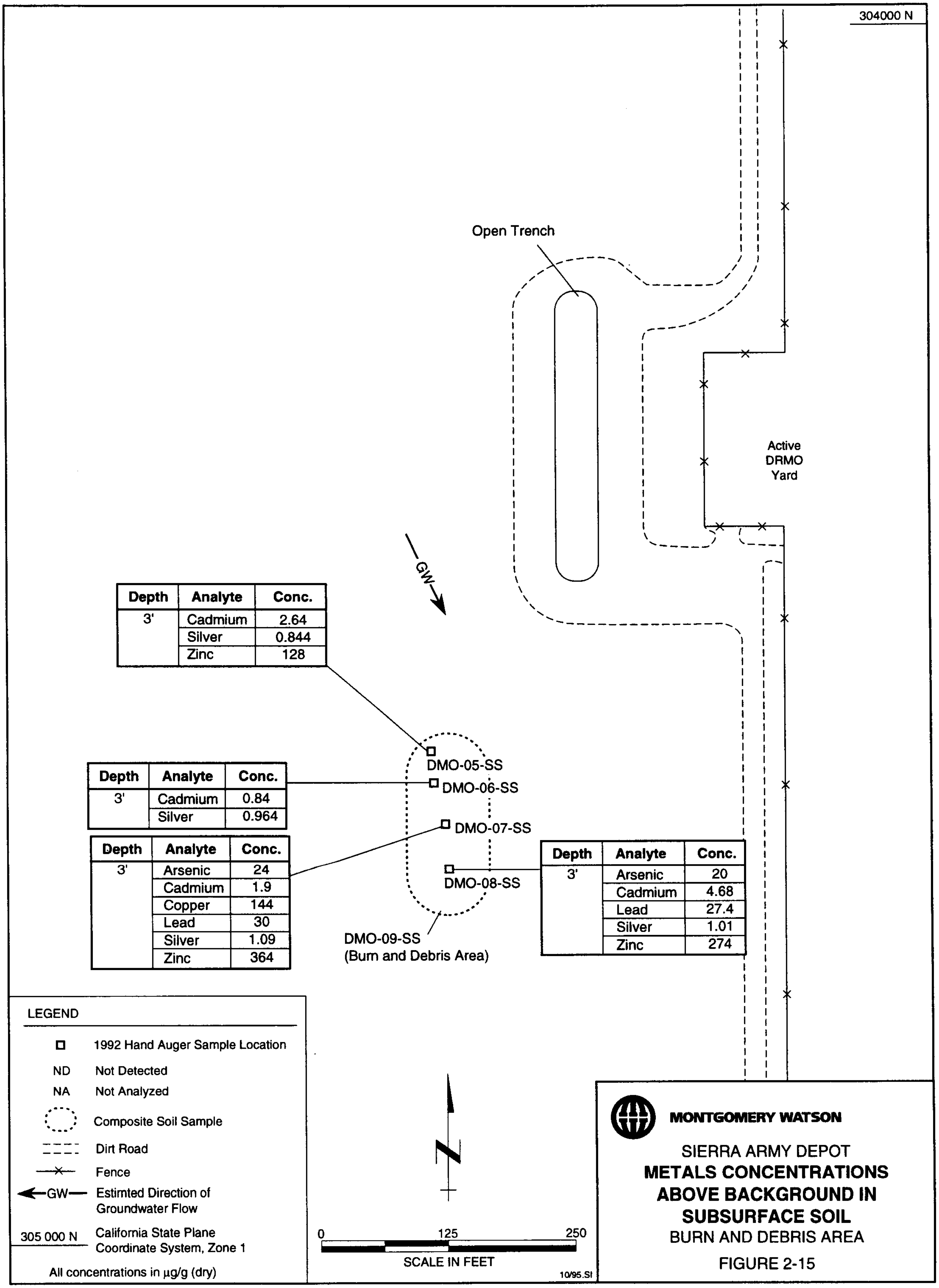
MONTGOMERY WATSON

SIERRA ARMY DEPOT

METALS CONCENTRATIONS ABOVE BACKGROUND IN SURFACE SOIL

BURN AND DEBRIS AREA

FIGURE 2-14



DMO-05-SS

Depth	Analyte	Conc.
3'	Cadmium	2.64
	Silver	0.844
	Zinc	128

DMO-06-SS

Depth	Analyte	Conc.
3'	Cadmium	0.84
	Silver	0.964

DMO-07-SS

Depth	Analyte	Conc.
3'	Arsenic	24
	Cadmium	1.9
	Copper	144
	Lead	30
	Silver	1.09
	Zinc	364

DMO-08-SS

Depth	Analyte	Conc.
3'	Arsenic	20
	Cadmium	4.68
	Lead	27.4
	Silver	1.01
	Zinc	274

LEGEND

- □ 1992 Hand Auger Sample Location
- ND Not Detected
- NA Not Analyzed
- Composite Soil Sample
- Dirt Road
- Fence
- ←GW— Estimted Direction of Groundwater Flow
- 305 000 N California State Plane Coordinate System, Zone 1

All concentrations in µg/g (dry)

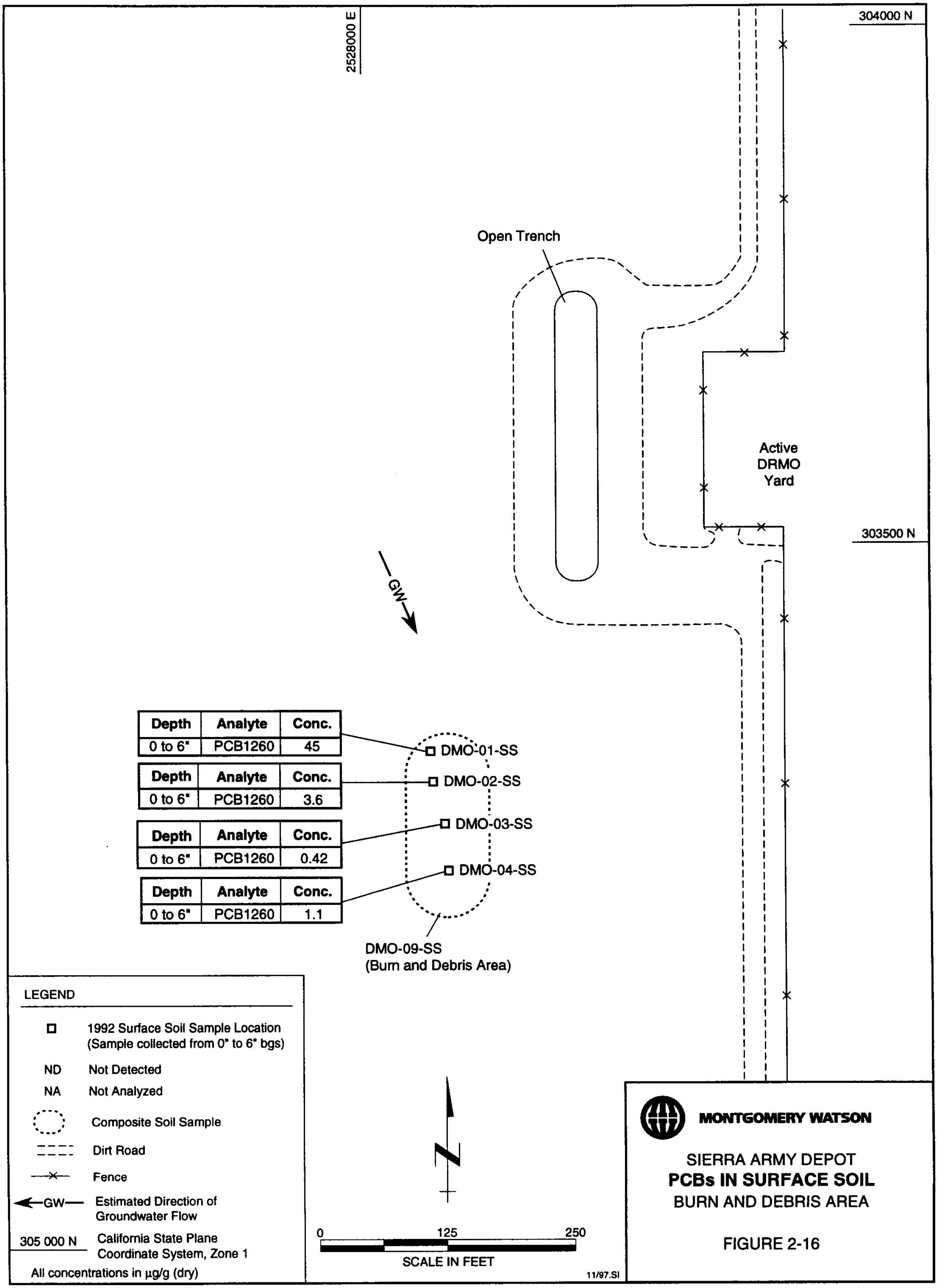
MONTGOMERY WATSON

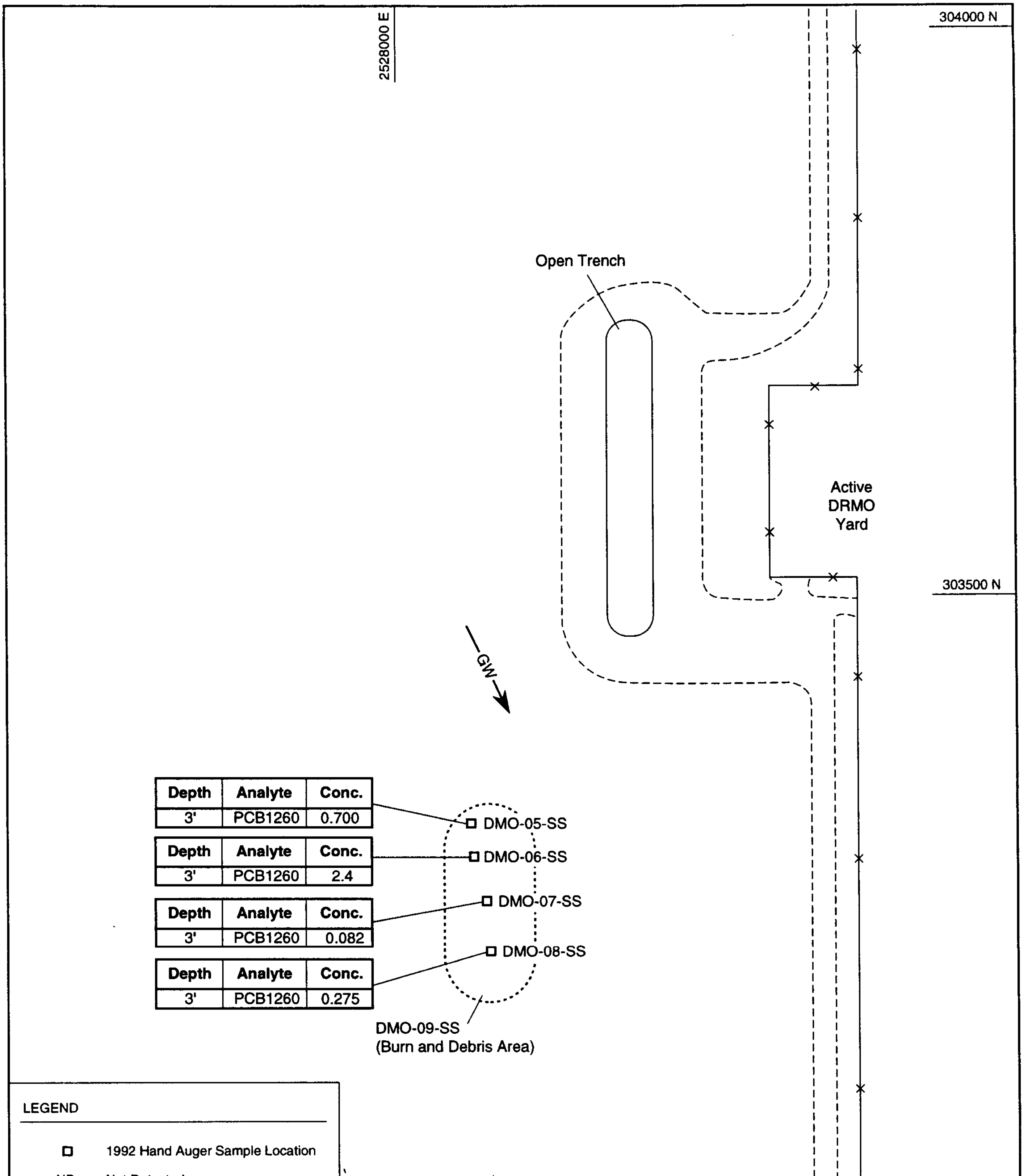
SIERRA ARMY DEPOT

METALS CONCENTRATIONS ABOVE BACKGROUND IN SUBSURFACE SOIL

BURN AND DEBRIS AREA

FIGURE 2-15


2528000 E
304000 N
303500 N
Open Trench
Active
DRMO
Yard
GW
Depth | Analyte | Conc.
0 to 6" | PCB1260 | 45
DMO-01-SS
Depth | Analyte | Conc.
0 to 6" | PCB1260 | 3.6
DMO-02-SS
Depth | Analyte | Conc.
0 to 6" | PCB1260 | 0.42
DMO-03-SS
Depth | Analyte | Conc.
0 to 6" | PCB1260 | 1.1
DMO-04-SS
DMO-09-SS
(Burn and Debris Area)
LEGEND
1992 Surface Soil Sample Location
(Sample collected from 0" to 6" bgs)
ND Not Detected
NA Not Analyzed
Composite Soil Sample
Dirt Road
Fence
GW Estimated Direction of
Groundwater Flow
305 000 N California State Plane
Coordinate System, Zone 1
All concentrations in µg/g (dry)
0
125
250
SCALE IN FEET
11/97.SI
MONTGOMERY WATSON
SIERRA ARMY DEPOT
PCBs IN SURFACE SOIL
BURN AND DEBRIS AREA
FIGURE 2-16



Depth	Analyte	Conc.
3'	PCB1260	0.700

Depth	Analyte	Conc.
3'	PCB1260	2.4

Depth	Analyte	Conc.
3'	PCB1260	0.082

Depth	Analyte	Conc.
3'	PCB1260	0.275

LEGEND

- □ 1992 Hand Auger Sample Location
- ND Not Detected
- NA Not Analyzed
- Composite Soil Sample
- Dirt Road
- Fence
- ←GW— Estimated Direction of Groundwater Flow
- 305 000 N California State Plane Coordinate System, Zone 1

All concentrations in µg/g (dry)

10/95.SI

MONTGOMERY WATSON

SIERRA ARMY DEPOT

PCBs IN SUBSURFACE SOIL

BURN AND DEBRIS AREA

FIGURE 2-17

TABLE 2-5

SUMMARY OF SURFACE AND SUBSURFACE SOIL ANALYTICAL DATA
BURN AND DEBRIS AREA

Analyte	Concentration Range (µg/g)	Total Number of Samples	Number of Detects	Number of Detects Greater than Background
Dioxins/Furans				
2,3,7,8-Tetrachlorodibenzofuran	0.00035 to 0.00035	1	1	na
Octachlorodibenzodioxin	0.000258 to 0.000258	1	1	na
Pentachlorodibenzofuran	0.000134 to 0.000134	1	1	na
Metals				
Antimony	nd to 274	8	2	2
Arsenic	6.32 to 24	8	8	2
Barium	196 to 329	8	8	0
Cadmium	0.85 to 48.1	8	8	8
Chromium	5.65 to 45.3	8	8	3
Cobalt	3.63 to 5.23	8	8	0
Copper	19 to 3700	8	8	5
Lead	nd to 1990	8	6	6
Mercury	nd to 0.0601	8	1	1
Molybdenum	1.48 to 5.65	8	8	2
Nickel	3.9 to 36.5	8	8	3
Selenium	nd to 0.502	8	1	1
Silver	0.844 to 3.89	8	8	7
Vanadium	18 to 35.4	8	8	0
Zinc	81.8 to 4080	8	8	7
Pesticides/PCBs				
PCB 1260	0.0822 to 45	8	8	na
p,p'-DDE	nd to 0.0155	8	3	na
SVOCs				
1,2,4-Trichlorobenzene	nd to 2	8	1	na
VOCs				
Chlorobenzene	nd to 0.0013	8	2	na
Toluene	nd to 0.0038	8	4	na
Trichloroethene	nd to 0.13	8	4	na

nd - not detected
na - not applicable

all test pits. Soil samples were collected from the surface and 5 feet bgs in each test pit and analyzed for VOCs, SVOCs, organochlorine (OC) pesticides/PCBs, California Title 22 metals, and TRPH. VOCs and SVOCs were not detected in soil at the DRMO Active Yard.

One additional soil boring was also drilled and sampled from beneath the open trench to the water table. A VOC source was not located in the DRMO Active Yard during the 1993 investigation.

2.5.2 Groundwater

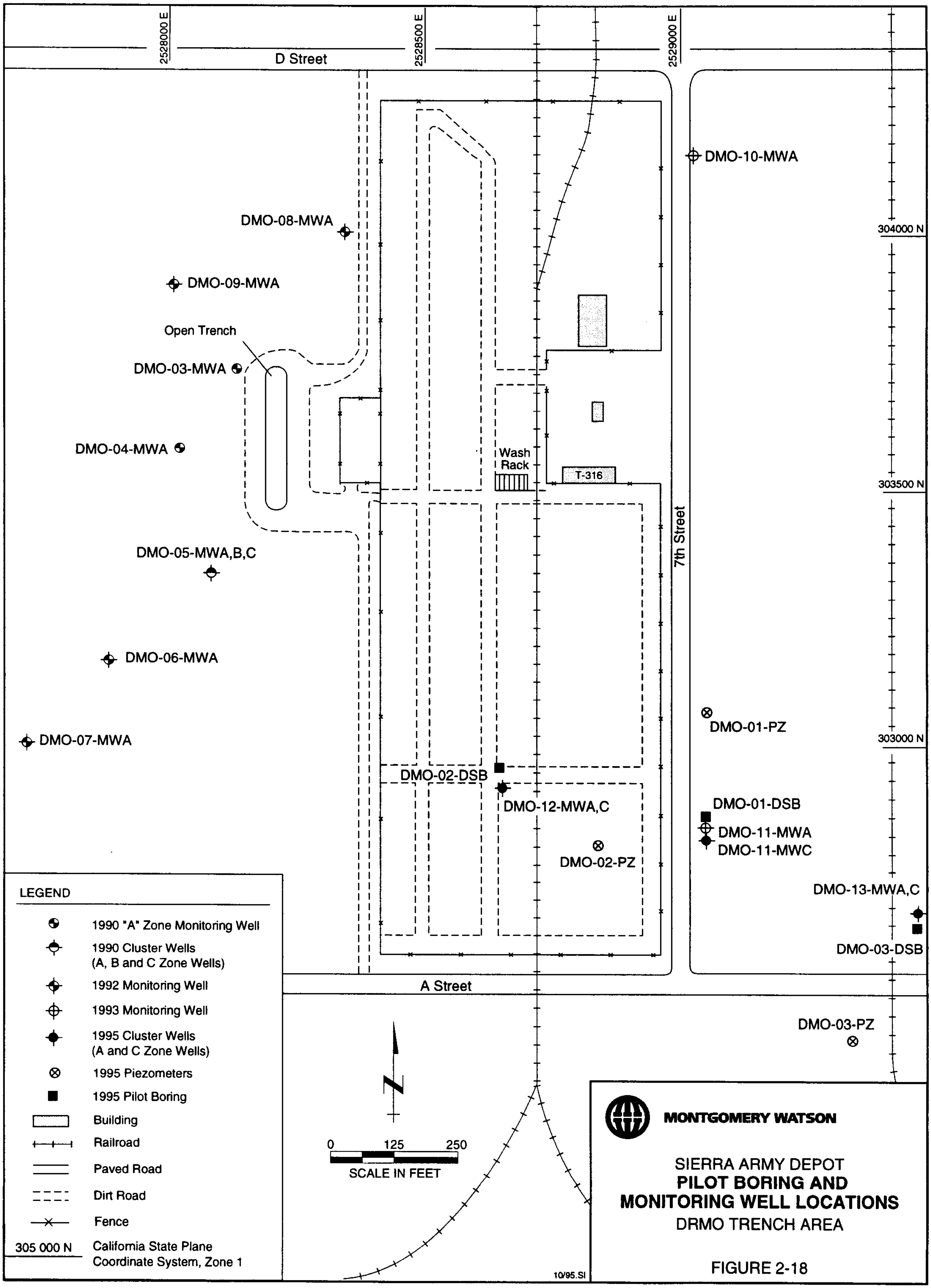
Groundwater was assessed based on investigations conducted in 1984 by the USAEHA and during the 1990 Group I RI, 1992 Group I Follow-Up RI, 1993 Group I and II Follow-Up RI, and the 1995 DRMO Follow-Up RI by Montgomery Watson.

2.5.2.1 USAEHA Investigation. Two monitoring wells were installed west and southwest of the DRMO Open Trench and sampled to investigate potential groundwater contamination due to disposal of liquid industrial wastes (Figure 2-5). These wells, however, are considered unusable due to a lack of information on well construction methods (Benioff, et al., 1988; Whitten, 1989).

2.5.2.2 1990 Group I Remedial Investigation. Three water table monitoring wells were installed during the 1990 Group I RI (Figure 2-18). TCE was detected in all three monitoring wells installed and sampled during the 1990 Group I RI. Groundwater from two of the three monitoring wells at this site registered TCE values above the California MCL (JMM and E.C. Jordan, 1991). The highest TCE concentration in groundwater (25.7 μg/L) was detected in the southernmost well (DMO-05-MWA), suggesting that TCE is migrating in a southern (downgradient) direction in this area. The boundaries of the TCE in the groundwater could not be defined due to a limited data set. The groundwater data collected during the 1990 Group I RI are presented on Table 2-6.

2.5.2.3 1992 Group I Follow-Up Remedial Investigation. Four water table, one “B” zone, and one “C” zone monitoring wells were installed and sampled in the DRMO Open Trench Area during the 1992 field program. In addition, two HydroPunch groundwater samples were collected from beneath the DRMO Active Yard. TCE was detected in four (DMO-03-MWA, DMO-04-MWA, DMO-05-MWA, and DMO-09-MWA) of seven "A" zone or water table monitoring wells and in both HydroPunch samples (DMO-01-HP and DMO-02-HP) (Figure 2-19). The highest concentration of TCE (13.6 μg/L) in the water table monitoring wells was detected in DMO-05-MWA. TCE was detected in the “B” zone monitoring well at 1.43 μg/L during the first round of groundwater sampling. This detection was not confirmed during subsequent rounds of sampling. TCE was not detected in the “C” zone well. The highest concentration of TCE (110 μg/L) in the HydroPunch samples was in DMO-02-HP, located approximately 500 feet southeast of DMO-05-MWA.

The TCE in the monitoring wells located around the DRMO open trench is related to soil contamination in the open trench. The origin of the TCE detected in the HydroPunch samples is



SIERRA ARMY DEPOT
PILOT BORING AND MONITORING WELL LOCATIONS
DRMO TRENCH AREA

FIGURE 2-18

TABLE 2-6

SUMMARY OF ORGANIC COMPOUNDS IN GROUNDWATER
DRMO TRENCH AREA
(Page 1 of 3)

			Concentration (µg/L)									
Analyte	State MCL	Federal MCL	Round 1	Round 2	Round 3	Round 4	Round 5	Round 6	Round 7	Round 8	Round 9	Round 10
DMO-03-MWA			4/19/90	5/31/90	4/29/91	7/22/91	2/24/92	5/4/92	10/16/93	1/11/94	-	-
TCE	5	5	10.50	2.57	45	4.95	5.05	11.40	27	7.6	na	na
Methylene Chloride	5	5	nd	7.45	nd	nd	nd	nd	nd	nd	na	na
Chloroform	100	100	nd	nd	1.33	nd	nd	nd	nd	nd	na	na
Toluene	150	1,000	nd	nd	3.00	nd	nd	nd	nd	nd	na	na
DMO-04-MWA			4/19/90	5/31/90	4/27/91	7/22/91	3/7/92	5/8/92	10/16/93	1/11/94	-	-
TCE	5	5	4.19	2.19	5.05	9.24	9.52	6.00	7	25	na	na
1,1,2-Trichloro-1,2,2-trifluoroethane	na	1,200	nd	nd	nd	nd	8.00	nd	nd	nd	na	na
Bis (2-ethylhexyl) phthalate	na	na	nd	nd	nd	nd	nd	6.91	na	na	na	na
DMO-05-MWA			4/19/90	5/31/90	4/18/91	7/22/91	3/16/92	5/9/92	10/17/93	1/11/94	-	-
TCE	5	5	25.70	18.10	21.00	15.20	13.60	13.30	15	8.3	na	na
Chloroform	100	100	nd	nd	nd	0.81	nd	nd	nd	nd	na	na
Methylene Chloride	5	5	nd	nd	2.36	nd	3.61	nd	nd	nd	na	na
Bis (2-ethylhexyl) phthalate	4	6	4.64	nd	nd	nd	9.09	5.91	na	na	na	na
DMO-05-MWB			-	-	-	-	4/22/92	5/9/92	10/17/93	1/19/94	-	-
TCE	5	5	-	-	-	-	1.43	nd	nd	nd	na	na
1,2-Dichloroethene	6*	70*	-	-	-	-	1.46	nd	nd	nd	na	na
Toluene	150	1000	-	-	-	-	0.51	nd	nd	nd	na	na
Bis(2-ethylhexyl)phthalate	4	6	-	-	-	-	74.50	nd	na	na	na	na
DMO-05-MWC			-	-	-	-	4/28/92	5/9/92	10/17/93	1/19/94	-	-
TCE	5	5	-	-	-	-	nd	nd	0.54	nd	na	na
Carbon Disulfide	na	na	-	-	-	-	1.70	nd	nd	nd	na	na
DMO-06-MWA			-	-	-	-	4/8/92	5/5/92	10/15/93	1/8/94	-	-
TCE	5	5	-	-	-	-	nd	nd	0.95	1.1	na	na
Chloroform	100	100	-	-	-	-	nd	1.44	nd	nd	na	na
Bis(2-ethylhexyl)phthalate	4	6	-	-	-	-	727.00	11.80	na	na	na	na
DMO-07-MWA			-	-	-	-	4/7/92	5/6/92	10/15/93	1/7/94	-	-
TCE	5	5	-	-	-	-	nd	nd	nd	nd	na	na
Bis(2-ethylhexyl)phthalate	4	6	-	-	-	-	909.00	nd	na	na	na	na
DMO-08-MWA			-	-	-	-	4/7/92	5/6/92	10/15/93	1/8/94	-	-
Bis(2-ethylhexyl)phthalate	4	6	-	-	-	-	43.60	6.82	nd	nd	na	na
DMO-09-MWA			-	-	-	-	4/6/92	5/7/92	10/15/93	1/8/94	-	-
TCE	5	5	-	-	-	-	3.81	3.71	8.3	6.6	na	na
Bis(2-ethylhexyl)phthalate	4	6	-	-	-	-	5.27	16.80	nd	6.6	na	na
DMO-10-MWA			-	-	-	-	-	-	10/30/93	1/9/94	-	-
TCE	5	5	-	-	-	-	-	-	nd	nd	na	na

TABLE 2-6

SUMMARY OF ORGANIC COMPOUNDS IN GROUNDWATER
DRMO TRENCH AREA

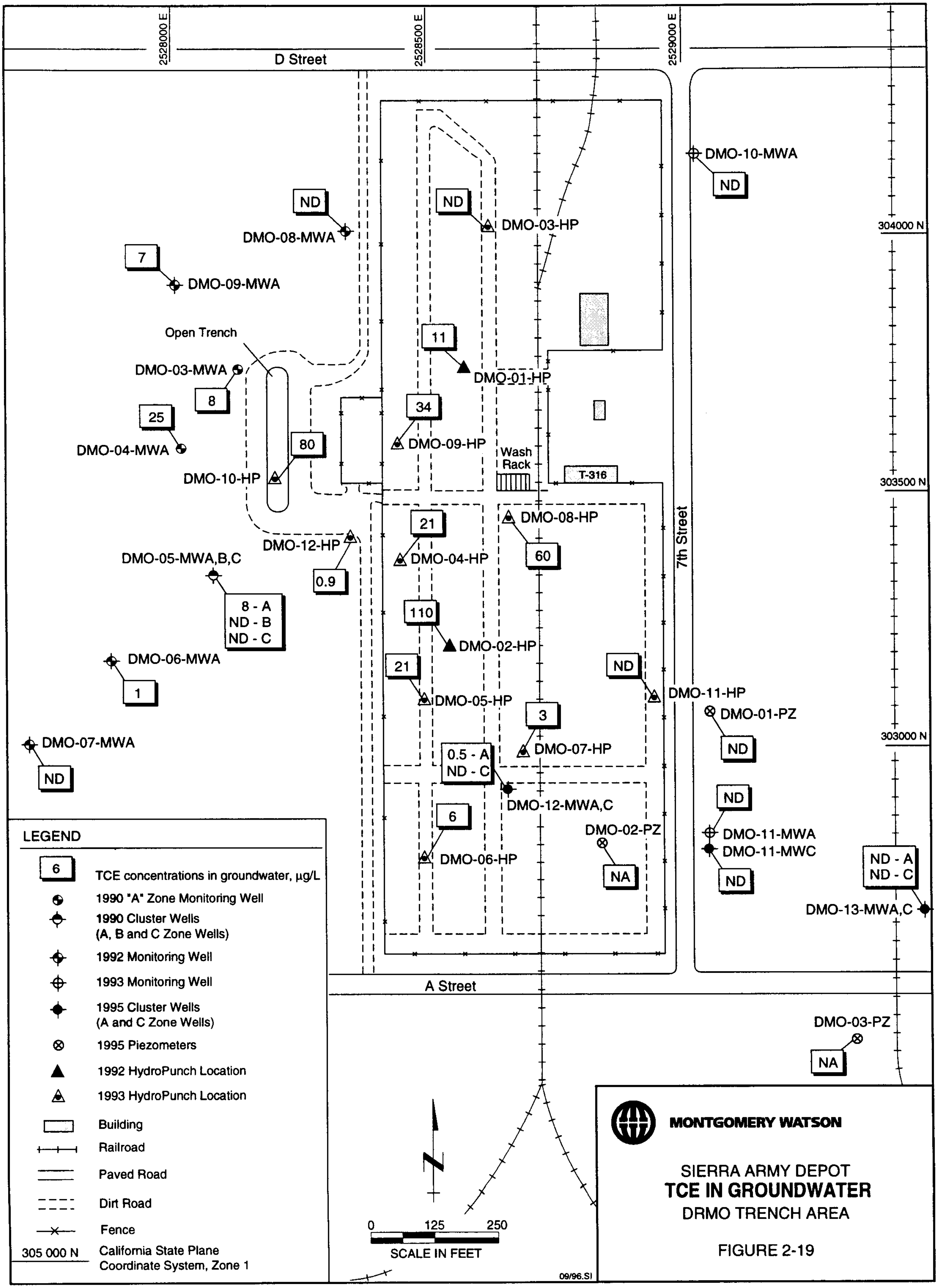
Analyte	State MCL	Federal MCL	Concentration (µg/L) Round 1	Round 2	Round 3	Round 4	Round 5	Round 6	Round 7	Round 8	Round 9	Round 10
DMO-11-MWA			-	-	-	-	-	-	10/28/93	1/9/94	4/14/95	5/23/95
TCE	5	5	-	-	-	-	-	-	nd	nd	nd	nd
Toluene	150	1,000	-	-	-	-	-	-	nd	nd	0.55	nd
DMO-11-MWC			-	-	-	-	-	-	-	-	4/14/95	5/23/95
Toluene	150	1,000	-	-	-	-	-	-	-	-	nd	9.1
DMO-12-MWA			-	-	-	-	-	-	-	-	4/12/95	5/22/95
TCE	5	5	-	-	-	-	-	-	-	-	1.2	0.49
DMO-12-MWC			-	-	-	-	-	-	-	-	4/12/95	5/22/95
Toluene	150	1,000	-	-	-	-	-	-	-	-	nd	4.7
DMO-13-MWA			-	-	-	-	-	-	-	-	4/11/95	6/4/95
Methylene chloride	5	5	-	-	-	-	-	-	-	-	nd	4.2
DMO-13-MWC			-	-	-	-	-	-	-	-	4/14/95	5/24/95
Organic Compounds			-	-	-	-	-	-	-	-	nd	nd
DMO-01-PZ			-	-	-	-	-	-	-	-	4/13/95	5/23/95
Organic Compounds			-	-	-	-	-	-	-	-	nd	nd
DMO-01-HP			-	-	-	-	-	9/29/92	-	-	-	-
TCE	5	5	-	-	-	-	-	11	-	-	-	-
Carbon Disulfide	na	na	-	-	-	-	-	14	-	-	-	-
Toluene	150	1,000	-	-	-	-	-	23	-	-	-	-
DMO-02-HP			-	-	-	-	-	9/29/92	-	-	-	-
TCE	5	5	-	-	-	-	-	110	-	-	-	-
DMO-03-HP			-	-	-	-	-	-	-	8/18/93	-	-
Bis(2-ethylhexyl)phthalate	4	6	-	-	-	-	-	-	-	6.2	-	-
Di-n-butyl phthalate	na	na	-	-	-	-	-	-	-	3.6	-	-
DMO-04-HP			-	-	-	-	-	-	-	8/19/93	-	-
TCE	5	5	-	-	-	-	-	-	-	21	-	-
Di-n-butyl phthalate	na	na	-	-	-	-	-	-	-	4.3	-	-
Methylene chloride	5	5	-	-	-	-	-	-	-	2.3	-	-
Xylenes	1750	10000	-	-	-	-	-	-	-	4.9	-	-
DMO-05-HP			-	-	-	-	-	-	-	8/19/93	-	-
TCE	5	5	-	-	-	-	-	-	-	21	-	-
TRPH	na	na	-	-	-	-	-	-	-	317	-	-

TABLE 2-6

SUMMARY OF ORGANIC COMPOUNDS IN GROUNDWATER
DRMO TRENCH AREA
(Page 3 of 3)

Analyte	State MCL	Federal MCL	Round 1	Round 2	Round 3	Round 4	Round 5	Round 6	Round 7	Round 8	Round 9	Round 10
			Concentration (µg/L)									
DMO-06-HP			-	-	-	-	-	-	-	9/2/93	-	-
TCE	5	5	-	-	-	-	-	-	-	5.5	-	-
Di-n-butyl phthalate	na	na	-	-	-	-	-	-	-	13	-	-
DMO-07-HP			-	-	-	-	-	-	-	8/19/93	-	-
TCE	5	5	-	-	-	-	-	-	-	3	-	-
DMO-08-HP			-	-	-	-	-	-	-	9/1/93	-	-
TCE	5	5	-	-	-	-	-	-	-	60	-	-
Bis(2-chloroethyl)ether	na	na	-	-	-	-	-	-	-	7.6	-	-
Bis(2-ethylhexyl)phthalate	4	6	-	-	-	-	-	-	-	9.1	-	-
Di-n-butyl phthalate	na	na	-	-	-	-	-	-	-	59	-	-
TRPH	na	na	-	-	-	-	-	-	-	218	-	-
DMO-09-HP			-	-	-	-	-	-	-	8/19/93	-	-
TCE	5	5	-	-	-	-	-	-	-	34	-	-
Di-n-butyl phthalate	na	na	-	-	-	-	-	-	-	3.7	-	-
Methylene chloride	5	5	-	-	-	-	-	-	-	3	-	-
DMO-10-HP			-	-	-	-	-	-	-	9/13/93	-	-
TCE	5	5	-	-	-	-	-	-	-	80	-	-
1,2,4-trichlorobenzene	70	70	-	-	-	-	-	-	-	5.9	-	-
1,2-dichlorobenzene	600	na	-	-	-	-	-	-	-	100	-	-
1,3-dichlorobenzene	na	na	-	-	-	-	-	-	-	15	-	-
1,4-dichlorobenzene	5	75	-	-	-	-	-	-	-	53	-	-
2-methylnaphthalene	na	na	-	-	-	-	-	-	-	4.5	-	-
Di-n-butyl phthalate	na	na	-	-	-	-	-	-	-	16	-	-
Naphthalene	na	na	-	-	-	-	-	-	-	2.1	-	-
Toluene	150	1000	-	-	-	-	-	-	-	7	-	-
Chlorobenzene	70	100	-	-	-	-	-	-	-	6	-	-
Xylenes	1750	10000	-	-	-	-	-	-	-	9	-	-
DMO-11-HP			-	-	-	-	-	-	-	9/14/93	-	-
Di-n-butyl phthalate	na	na	-	-	-	-	-	-	-	6.1	-	-
Acetone	na	na	-	-	-	-	-	-	-	97	-	-
Methyl ethyl ketone	na	na	-	-	-	-	-	-	-	200	-	-
DMO-12-HP			-	-	-	-	-	-	-	9/18/93	-	-
TCE	5	5	-	-	-	-	-	-	-	0.91	-	-

na - not analyzed/not applicable
nd - not detected
* MCL for cis-1,2-Dichloroethene



SIERRA ARMY DEPOT
TCE IN GROUNDWATER
DRMO TRENCH AREA

FIGURE 2-19

uncertain but may be due to a second or multiple sources located in the DRMO active yard. The groundwater data collected during the 1992 Group I Follow-Up RI are presented on Table 2-6.

2.5.2.4 1993 Group I and II Follow-Up Remedial Investigation. Two water table monitoring wells and nine HydroPunch borings were installed in and just east of the DRMO Active Yard. One additional HydroPunch groundwater sample was collected from the water table directly below the open trench. TCE was detected in seven of nine HydroPunch groundwater samples collected from beneath the active yard. The highest concentration of TCE detected beneath the active yard during the 1993 field program was in DMO-08-HP at 60 µg/L. TCE and several SVOCs, including 1,2,4-trichlorobenzene, 1,2-dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, 2-methylnaphthalene, naphthalene, and chlorobenzene, were detected in the HydroPunch groundwater sampled collected beneath the open trench. TCE was not detected in the new monitoring wells installed east of the DRMO Active Yard. The groundwater data collected during the 1993 Group I and II Follow-Up RI are presented on Table 2-6.

An anomalous groundwater elevation was detected in one well, DMO-11-MWA, at the southeast corner of the active yard. The groundwater elevation in DMO-11-MWA was observed to be more than 7.5 feet higher than the groundwater elevations in surrounding monitoring wells.

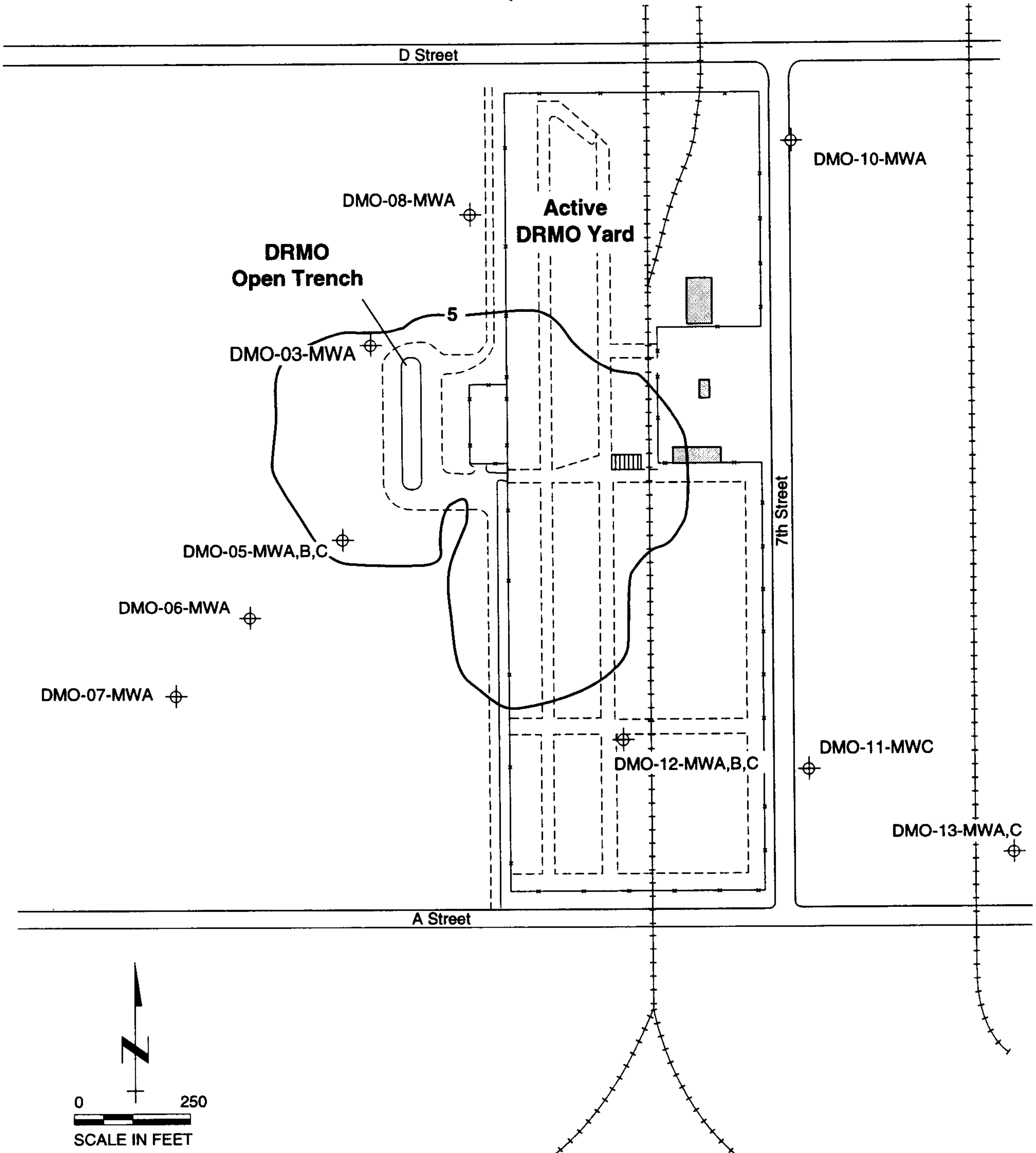
2.5.2.5 1995 DRMO Follow-Up Remedial Investigation. The investigation included the installation of three pilot borings to 200 feet bgs, borehole geophysical logging of each pilot boring, installation and sampling of three cluster wells and three water table piezometers. The screened intervals in the deep zone wells were selected based on data obtained from the pilot borings. The results of the investigation indicated that a groundwater mound is localized in the area around DMO-11-MWA and does not appear to significantly affect the groundwater movement in the remainder of the site. The cause of the groundwater mound is unknown. TCE was not detected in the cluster wells installed east of the active yard. TCE was detected at low levels in the water table monitoring well installed within the active yard (DMO-12-MWA) but not in the deep well associated with it (DMO-12-MWC). The groundwater data collected during the 1995 DRMO Follow-Up RI are presented in Table 2-6. Figure 2-20 presents the approximate extent of TCE in groundwater at the DRMO Trench Area.

2.6 SUMMARY OF SITE RISKS

To determine the potential human health and environmental risks (both current and future) associated with exposure to contaminants at the DRMO Trench Area, a baseline risk assessment (BRA) was conducted. The BRA consisted of a human health risk assessment and environmental assessment. The results of the human health risk assessment and environmental assessment are discussed in Sections 2.6.1 and 2.6.2, respectively.

2.6.1 Human Health Risks

The human health risk assessment is an analysis of the potential adverse health effects (both current and future) resulting from human exposure to site contaminants. By definition, a human



LEGEND

5	Extent of TCE Groundwater Contamination (5 µg/l)
DMO-17-MWA	Existing Monitoring Well

MONTGOMERY WATSON

SIERRA ARMY DEPOT
EXTENT OF TCE IN GROUNDWATER
DRMO TRENCH AREA

FIGURE 2-20

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health risk assessment considers conditions under the no-action alternative, that is, in the absence of any remedial actions to control or mitigate exposure. The basic methodology used in the human health risk assessment was developed by the USEPA for evaluation of risk at hazardous waste sites (USEPA, 1989b). Overall, this methodology is health protective, which means that the true risks from the site are unlikely to be higher than the derived estimates, and are most likely lower. The following sections discuss the human health risk assessment methodology.

2.6.1.1 Identification of Compounds of Concern. A list of the COCs for the site was developed through comparison to background levels, frequency of analyte detection, and contribution towards site-specific toxicity. The compounds of concern (COCs) for each subarea of the DRMO Trench Area site are listed below:

<u>**DRMO Open Trench Soil**</u>

The following VOCs, SVOCs, metals, and petroleum hydrocarbons are COCs in soil at the DRMO Open Trench: chlorobenzene, ethylbenzene, PCE, TCE, toluene, xylenes, benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, chrysene, 1,2-dichlorobenzene, 1,4-dichlorobenzene, indeno(1,2,3-C,D)pyrene, antimony, TPH-gas, and TPH-diesel.

<u>**Burn and Debris Area Soil**</u>

The following organics and metals are COCs in soil at the Burn and Debris Area: PCB-1260 and antimony.

<u>**DRMO Trench Area Groundwater**</u>

The sole COC for groundwater at the DRMO Trench Area is TCE.

2.6.1.2 Exposure Assessment. An exposure assessment was conducted to identify potential transport pathways (e.g., exposure to soil and groundwater); routes of exposures (e.g., ingestion, inhalation, dermal contact); and potential on- and off-site receptor populations. The major transport pathways are potential exposure to contaminated soil and potential use of groundwater containing COCs. Three exposure scenarios: the intermittent worker, future construction worker, and future resident (adult and child) were considered for the DRMO Trench Area.

The current intermittent worker is assumed to be a civilian full-time worker at another SIAD location who may visit the DRMO Trench Area infrequently to discard debris or other materials or for some unspecified reason. Exposure to soil could result in inhalation, ingestion, and dermal exposure to fugitive dust.

Future construction worker exposure to soil may occur during various construction-related activities at the DRMO Trench Area. In the future, construction activities might result in bringing subsurface soil to the surface and removing any impediments to erosion in the process.

Therefore, for the future construction worker, erosion due to wind and vehicular traffic is likely to result in exposure to contaminants in air and this pathway was quantified. Therefore, exposure to soil could result in inhalation, ingestion, and dermal exposure to fugitive dust.

Exposure pathways for hypothetical future residents (adult and child) includes ingestion, inhalation, and potential residential use of groundwater. Exposure probably occurs both indoors (from intake of household dust) and outdoors (while playing, gardening, or doing yard work). In the future, it is possible that hypothetical on-site residents might install wells for drinking water and other indoor uses (toilets, sinks, etc.). Pathways of exposure to contaminants in groundwater used for household purposes include not only ingestion, but also dermal contact (while showering or bathing) and inhalation of volatile chemicals released from household water uses into indoor air. All three pathways were quantitatively evaluated for hypothetical future residents at the DRMO Trench Area. Current exposure to the potable wells being used by off-site residents was not evaluated because no site-related contaminants were detected in these wells.

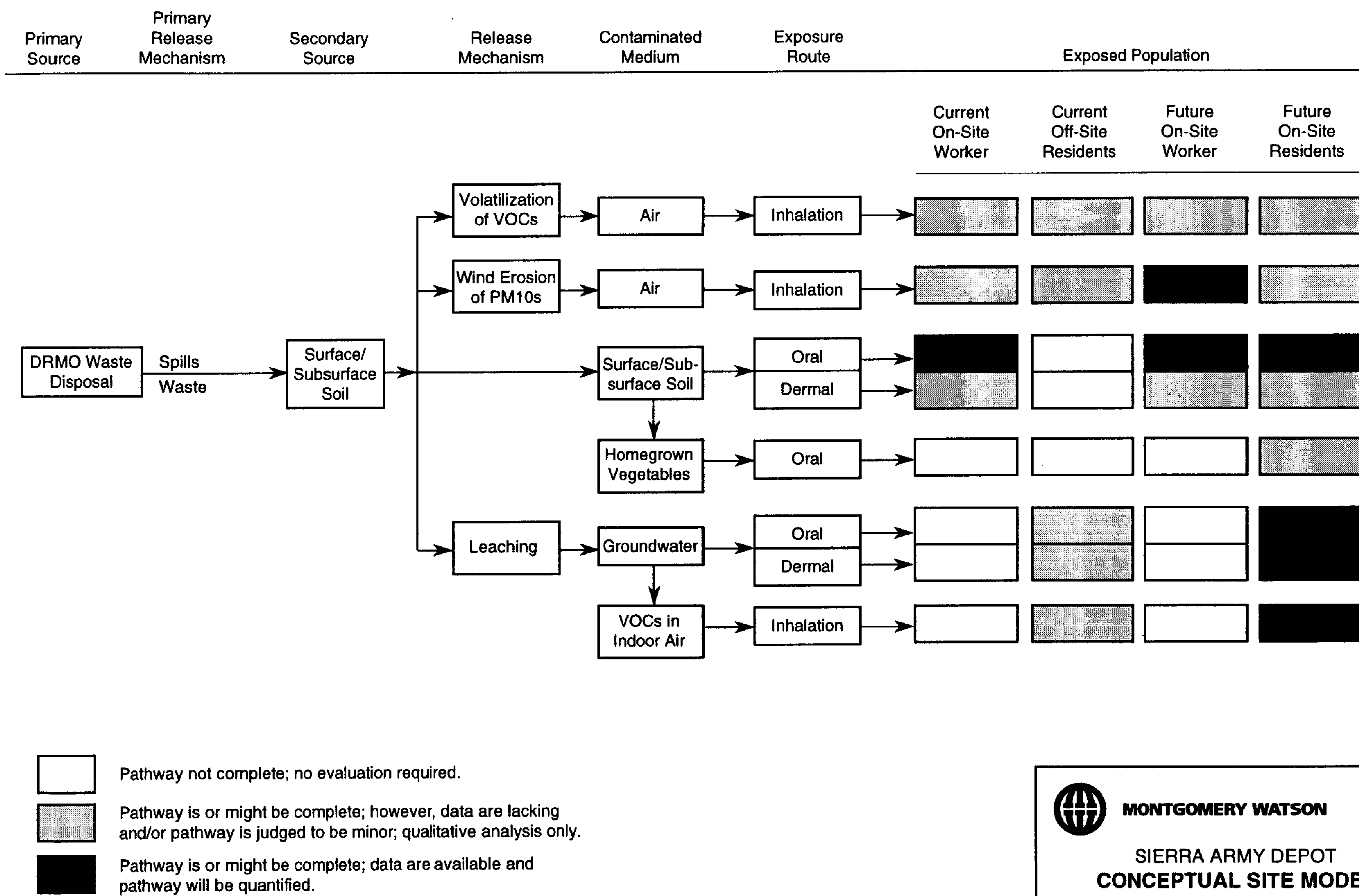
Figure 2-21 presents the conceptual site model for potential human exposure at the DRMO site. Table 2-7 summarizes potential pathways of exposure and potential receptor populations associated with the DRMO Trench Area.

2.6.1.3 Toxicity Assessment. The toxic effects of a chemical generally depend on the level of exposure (dose), the route of exposure (oral, inhalation, dermal), and the duration of exposure (subchronic, chronic, or lifetime). Thus, a full description of the toxic effects of a chemical includes a listing of what adverse health effects the chemical can cause (both cancer and noncancer), and how the occurrence of these effects depends upon dose, route, and duration of exposure.

When data permit, the USEPA derives numeric values that are useful in quantifying the toxicity and carcinogenicity of a compound. For noncancer health effects, the values are termed reference doses (RfDs). These are route- and duration-specific estimates of the average daily intake (mg chemical/kg-day) that may occur without appreciable risk of any adverse effect. Because the quality and quantity of toxicologic data available to support derivation of RfD values varies among chemicals, USEPA also provides an indication of the overall confidence associated with each RfD value. In general, the lower the confidence, the more conservative the USEPA is in deriving the RfD.

For cancer, the numeric descriptors of carcinogenic potency are termed slope factors (SFs). These are route-specific estimates of the slope of the cancer dose-response curve at low doses. It is assumed the curve is linear in this region and passes through the origin. The units of the SFs are $(mg/kg\text{-}day)^{-1}$. In addition, USEPA assigns a cancer weight-of-evidence category to each chemical in order to reflect the overall confidence that chemical is likely to cause cancer in humans.

Since dermal exposure to groundwater is also of concern at the site, dermal toxicity values are also required. It is important to note that dermal toxicity values must be based on the absorbed dose (rather than the exposed or administered dose), since dermal intakes are calculated as



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SIERRA ARMY DEPOT

CONCEPTUAL SITE MODEL

DRMO OPEN TRENCH

FIGURE 2-21

TABLE 2-7

EXPOSURE PATHWAYS QUANTIFIED FOR THE DRMO TRENCH AREA

Population	Exposure Point	Exposure Medium	Exposure Route
Current			
Intermittent Worker	DRMO (Ash Pile and Trench Perimeter)	Soil	Ingestion
Future			
On-Site Resident (Adult/Child)	DRMO (Ash Pile and Trench Perimeter)	Goundwater	Ingestion Dermal
		Indoor Air	Inhalation
		Soil	Ingestion
Construction Worker	DRMO (Ash Pile and Trench Perimeter)	Soil	Ingestion
		Ambient Air	Inhalation

absorbed doses. Since the USEPA has not yet established any dermal toxicity values, approximate values were derived by extrapolation from oral toxicity values. This was done by multiplying the oral subchronic or chronic RfD values by the oral absorption fraction (AF_o), and dividing the oral slope factor by the oral absorption fraction.

In evaluating dermal exposures in water, another toxicological parameter, the permeability constant (PC), is required (also referred to as P or KP). Permeability constants reflect the movement of a chemical across the skin into the bloodstream. Permeability constants have been experimentally determined for a limited number of chemicals. For organic compounds, PC can be estimated based on molecular weight and log K_{ow}.

2.6.1.4 Risk Characterization. The risk of cancer from exposure to a chemical is described in terms of the probability that an individual exposed for his or her lifetime will develop cancer. Typically, excess cancer risks of one in a million (1E-06) or lower are considered to be so small that they are of no practical concern. Higher cancer risk levels may be cause for concern, and the USEPA typically requires remediation of a site if risks exceed 1E-04. Estimated cancer risks from exposures to the chemicals of potential concern at the DRMO Trench Area are summarized in Tables 2-8 through 2-10.

Carcinogenic risk for hypothetical future populations is dominated by oral exposure to soil and groundwater, with excess cancer risks ranging from 2E-05 (average [AVG]) to 8E-04 (reasonable maximum exposure [RME]). Chemicals contributing to these values are mainly PCB-1260, arsenic, and polycyclic aromatic hydrocarbons (PAHs). Risk values from direct ingestion of soil range from 6E-07 (AVG) to 6E-04 (RME) due primarily to PCB-1260 and arsenic, and to a lesser degree, PAHs and 1,4-dichlorobenzene. Risks from groundwater ingestion range from 2E-05 (AVG) to 2E-04 (RME), mainly from arsenic.

Evaluation of noncarcinogenic risk is accomplished by comparing a calculated intake with an acceptable intake for each chemical and for each pathway that contributes to a population's exposure. The ratio of the calculated intake versus the acceptable intake is termed the hazard index (HI).

Subchronic and chronic noncancer risks exceeded 1 for hypothetical future populations for the soil (AVG and RME) and groundwater (RME) ingestion pathway. The major contributor to the risk from soil is antimony, with hazard quotient (HQ) values ranging 0.04 (AVG) to 9 (RME) in soil. Groundwater risks are from 0.5 (AVG) to 3 (RME) and are primarily due to arsenic and bis(2-ethylhexyl)phthalate.

The likely effect of exposures to lead from site contamination is blood lead levels in young children; these levels were estimated using the UBK model. The highest geometric mean blood lead level predicted for the residential population evaluated is 5.1 micrograms per deciliter (μg/dL), with less than 3 percent of the population expected to have values above 10 μg/dL. Therefore, it appears that lead is not a source of concern at this site.

TABLE 2-8

SUMMARY OF POTENTIAL CANCER AND NONCANCER RISKS
DRMO OPEN TRENCH

Site	Exposure Case			
	Cancer Risk		Hazard Index	
Pathway	Average	RME	Average	RME
Current Intermittent Worker				
Soil Ingestion	NC	NC	NC	NC
Soil Inhalation	NC	NC	NC	NC
Dermal	NC	NC	NC	NC
Total	NC	NC	NC	NC
Future Construction Worker				
Soil Ingestion	8E-07	**3E-06** [a]	1E-01	6E-01
Soil Inhalation	5E-07	9E-07	2E-04	2E-03
Dermal	NC	NC	NC	NC
Total	1E-06	**4E-06** [a]	1E-01	6E-01
Future Adult Resident				
Soil Ingestion	NC	NC	NC	NC
Soil Inhalation	NC	NC	NC	NC
Dermal	NC	NC	NC	NC
Total	NC	NC	NC	NC
Future Child Resident				
Soil Ingestion	NC	NC	NC	NC
Soil Inhalation	NC	NC	NC	NC
Dermal	NC	NC	NC	NC
Total	NC	NC	NC	NC

NC = Not Calculated

Hazard index is subchronic for future construction workers.

Values that are above levels of concern are shown in bold.

[a] Cancer risk is due to TCE and 1,4-dichlorobenzene.

TABLE 2-9

SUMMARY OF POTENTIAL CANCER AND NONCANCER RISKS
DRMO OPEN TRENCH PERIMETER

Site	Exposure Case			
	Cancer Risk		Hazard Index	
Pathway	Average	RME	Average	RME
Current Intermittent Worker				
Soil Ingestion	3E-08	6E-07	4E-04	3E-03
Soil Inhalation	NC	NC	NC	NC
Soil-Dermal	NC	NC	NC	NC
Groundwater Ingestion	NC	NC	NC	NC
Groundwater-Dermal	NC	NC	NC	NC
Total	3E-08	6E-07	4E-04	3E-03
Future Construction Worker				
Soil Ingestion	6E-07	**2E-06**[a]	1E-01	5E-01
Soil Inhalation	5E-07	**1E-06**[a]	4E-07	7E-07
Soil-Dermal	NC	NC	NC	NC
Groundwater Ingestion	NC	NC	NC	NC
Groundwater-Dermal	NC	NC	NC	NC
Total	1E-06	**3E-06**[a]	1E-01	5E-01
Future Adult Resident				
Soil Ingestion	**3E-06**[a]	**8E-05**[a]	4E-02	4E-01
Soil Inhalation	NC	NC	NC	NC
Soil-Dermal	NC	NC	NC	NC
Groundwater Ingestion	2E-05	1E-04	3E-01	6E-01
Groundwater-Dermal	1E-07	1E-06	2E-02	4E-02
Groundwater-Inhalation	1E-06	7E-06	4E-04	5E-04
Total	**2E-05**[a]	**2E-04**[a]	4E-01	1E+00
Future Child Resident				
Soil Ingestion	NC	NC	4E-01	**2E+00**[b]
Soil Inhalation	NC	NC	NC	NC
Soil-Dermal	NC	NC	NC	NC
Groundwater Ingestion	NC	NC	5E-01	1E+00
Groundwater-Dermal	NC	NC	2E-03	3E-03
Groundwater-Inhalation	NC	NC	1E-03	1E-03
Total	NC	NC	9E-01	**3E+00**[b]

NC = Not Calculated

Hazard index is subchronic for child residents and future construction workers and chronic for all other populations.

Values that are above levels of concern are shown in bold.

[a] Cancer risks are due to benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, and indeno(1,2,3-C,D)pyrene.

[b] Noncancer hazard index is due to antimony.

TABLE 2-10

SUMMARY OF POTENTIAL CANCER AND NONCANCER RISKS
DRMO BURN AND DEBRIS AREA

Site	Exposure Case			
	Cancer Risk		Hazard Index	
Pathway	Average	RME	Average	RME
Current Intermittent Worker				
Soil Ingestion	1E-07	**3E-06** [a]	1E-03	2E-02
Soil Inhalation	NC	NC	NC	NC
Soil-Dermal	NC	NC	NC	NC
Groundwater Ingestion	NC	NC	NC	NC
Groundwater-Dermal	NC	NC	NC	NC
Total	1E-07	**3E-06** [a]	1E-03	2E-02
Future Construction Worker				
Soil Ingestion	**2E-06** [a]	**1E-05** [a]	5E-01	**3E+00** [b]
Soil Inhalation	**1E-06** [a]	**1E-06** [a]	2E-06	6E-06
Soil-Dermal	NC	NC	NC	NC
Groundwater Ingestion	NC	NC	NC	NC
Groundwater-Dermal	NC	NC	NC	NC
Total	**3E-06** [a]	**1E-05**	5E-01	**3E+00** [b]
Future Adult Resident				
Soil Ingestion	**1E-05** [a]	**6E-04** [a]	1E-01	**2E+00** [b]
Soil Inhalation	NC	NC	NC	NC
Soil-Dermal	NC	NC	NC	NC
Groundwater Ingestion	2E-05	2E-04	4E-01	2E+00
Groundwater-Dermal	3E-07	4E-06	2E-02	8E-02
Groundwater-Inhalation	2E-06	1E-05	4E-04	5E-04
Total	**3E-05** [a]	**8E-04** [a]	5E-01	**4E+00** [b]
Future Child Resident				
Soil Ingestion	NC	NC	1E+00	**9E+00** [b]
Soil Inhalation	NC	NC	NC	NC
Soil-Dermal	NC	NC	NC	NC
Groundwater Ingestion	NC	NC	8E-01	3E+00
Groundwater-Dermal	NC	NC	5E-03	3E-02
Groundwater-Inhalation	1E-06	7E-06	1E-03	2E-03
Total	NC	NC	2E+00	**1E+01** [b]

NC = Not Calculated

Note: Hazard index is subchronic for child resident and future construction workers and chronic for all other populations.

Values that are above levels of concern are shown in bold.

[a] Cancer risks are due to PCB-1260.

[b] Noncancer hazard index is due to antimony.

2.6.1.5 **Summary.** The baseline human health risk assessment (HHRA) conducted for the DRMO Trench Area RI concluded that elevated cancer risks exist for hypothetical future populations at the Burn and Debris Area and DRMO Open Trench.

2.6.1.6 **Uncertainties.** There are a number of stages in the risk assessment process where precise evaluations are not possible. These include uncertainties regarding the true concentrations of chemicals in environmental media, the amount of contaminants taken in by humans, and the likely consequences of the resulting exposure. Some of these limitations lead to an underestimate of risk (e.g., lack of appropriate toxicity data, inability to quantify some exposure pathways), while other assumptions and professional judgments made are more likely to overestimate than underestimate risk. Consequently, the risks derived for this site should be considered to be only approximate.

2.6.2 Environmental Risks

This section addresses the potential risks that the COPCs identified at the DRMO Trench Area may have on the flora and fauna of the area. It provides a qualitative evaluation of the potential current and future risks represented by the present site conditions. By definition, an environmental assessment considers site conditions under the no-action alternative, this is, in the absence of any remedial actions to control or mitigate exposure.

2.6.2.1 **Potentially Exposed Populations.** Recreationally important species (mule deer, game birds) and endangered or threatened species (peregrine falcon, bald eagle, Aleutian goose) are potentially exposed populations at the DRMO Trench Area. Due to the lack of vegetation in the immediate vicinity of the DRMO Trench Area, it is expected that mule deer would infrequently visit these areas. Similarly, the Aleutian goose is an aquatic species and would likely confine its activities to the immediate vicinity of Honey Lake.

SIAD may be within the feeding range of the two remaining species, peregrine falcons and bald eagles. However, it is expected they would rarely utilize the site, as studies of feeding habits show that these species prefer aquatic or mountainous habitats for hunting (Gandy, 1989). Peregrine falcons sometimes prey on game bird species (e.g., quail, chukar, pigeons). However, rare and endangered species are unlikely to be exposed to chemicals of potential concern at any of the sites.

Potentially exposed populations at each of the sites would most likely be small burrowing rodents with a limited feeding range (Smith, 1974). Rodents are omnivorous and would be expected to be exposed to contaminants through inhalation and dermal contact as a result of their soil burrowing habits. Ingestion of contaminated food sources and/or soil would also be an exposure pathway for these populations. Bird populations could be exposed to contaminants through inhalation, direct contact, and ingestion of contaminated food sources. Most bird species utilizing the sites would be expected to be transient.

2.6.2.2 **Bioaccumulation Potential.** The only chemicals of concern at the DRMO Trench Area that may bioaccumulate and biomagnify are the PCB-1260, the pesticides DDT, DDD, DDE, chlordane, and the dioxin/dibenzofurans. These compounds are highly lipophilic, environmentally stable, and are reported to accumulate in adipose tissue. Additionally, the arid climate and scarcity of organic soil at the DRMO Trench Area will limit any microbial degradation that could naturally occur. Plants are known to take up these compounds through their root systems.

There may be some potential for small animals to ingest soil contaminated with pesticides. These animals in turn may be eaten by raptors frequenting the area. However, the low concentrations of pesticides, small areal extent of the contaminated sites, and typical range of raptors combine to minimize the possibility of significant wildlife biomagnification of pesticides. Metal contaminants including arsenic, cadmium, lead, and selenium, which could be stored by plants and animals, are not present in sufficient concentrations to cause concern.

2.6.2.3 Potential Risks to Ecological Populations. Although the concentrations of pesticides and PCB-1260 at the DRMO Trench Area are relatively low, these compounds pose a potential threat to wildlife populations that may inhabit the site. However, it is unlikely that species of special concern (i.e., bald eagles, peregrine falcons, Aleutian geese, game birds and mule deer) depend on the site for food and shelter to any significant degree. The habitat of this site relative to nearby areas is unsuitable or marginal for each of the noted species. Furthermore, the quality of hunting/foraging available for these species at the DRMO Trench Area are poor. For example, bald eagles and peregrine falcons would only utilize common mammals found at this site (rodents) as a secondary food source (Gandy, 1989). These factors, combined with the expanded home ranges for these species in unproductive environments (Smith, 1974), suggest minimal utilization of the DRMO Trench Area. Although acute exposure to these populations may occur, the probability is also quite low based on the small surface area of the site. It is unlikely that any community level or ecosystem impacts are due to contamination detected at the DRMO Trench Area.

Burrowing rodents are the vertebrates most likely to be exposed to site contaminants. Based on multiple potential exposure routes (inhalation, ingestion of contaminated food, and contact with contaminated soil), their potential exposure is greater than other species.

2.6.2.4 Limitations. The most significant limitations associated with the environmental assessment include:

- Knowledge of the degree to which wildlife utilize the site.
- Lack of specific data on concentrations of contaminants in plant tissue.
- Limited information on ecological toxicity to site-specific compounds.

2.6.2.5 Environmental Assessment Summary. Metals are present at the DRMO Trench Area in low concentrations; they are comparable to background and acceptable values for soil used for parkland or industrial uses. Cadmium, chromium, copper, lead, and zinc are present at levels that are slightly to moderately elevated above background. These chemicals are not likely to pose a hazard to desert animals or plants at measured concentrations. Copper, lead and zinc are present in the Burn and Debris Area at concentrations high enough to warrant attention.

However, the relative isolation of this sampling point indicates that this source does not present an undue hazard to the environmental receptors that could have contact with these contaminants.

The organochlorine pesticides, PCB-1260 and dioxin/dibenzofurans, present at the DRMO Trench Area may be a cause for concern because of their persistence in the environment, ability to bioaccumulate, and potential to adversely affect endangered bird species, as well as burrowing animals. More suitable feeding grounds exist within the flight range of these species. Consequently, although exposure potential exists at the DRMO Trench Area, they are not predicted to be of major importance, due to the limited areal extent of the site, particularly in comparison to the overall area of the Honey Lake Basin.

VOCs present at the DRMO Trench Area are in moderate to low concentrations and are not persistent in surface soil. The low bioaccumulation potential indicates that there is less opportunity for these compounds to have a cumulative effect on wildlife, including threatened raptors, which have been found near the site. The dominant route by which these birds could be exposed to contaminants is through ingestion of small mammals. The VOCs are not considered to be a significant risk to environmental receptors.

2.7 DESCRIPTION OF ALTERNATIVES

This section discusses the remedial alternatives that were developed and evaluated for the DRMO Open Trench soil, the Burn and Debris Area soil, and the DRMO Trench Area groundwater in the feasibility study (Montgomery Watson, 1997). It should be noted that costs for each alternative were estimated based on vendor phone quotes and commercially available cost estimating guides. Cost estimates were performed in accordance with USEPA recommendations using an accuracy range of +50 percent to -30 percent (USEPA, 1987). The cost evaluation is based upon estimates for capital costs and annual operation and maintenance costs. Because the alternatives have differing implementation time frames, a present worth has been calculated for each based on a discount rate of 7 percent. The present worth analysis provides a single figure representing the amount of money, that, if invested in the base year and dispersed as needed, would cover all costs associated with the alternative. The present worth calculation normalizes alternatives that have differing operating lifetimes, thus facilitating comparisons. A maximum timeframe of 30 years was assumed for those alternatives with long-term monitoring.

The cost estimates have been developed for the purpose of comparing alternatives. Specific cost elements are based on factors and a conceptual design, not a detailed design. Consequently, the list of equipment may not be complete and the total estimated costs may not reflect actual costs incurred during the remediation project. Also, the estimated costs assume no changes in regulatory requirements and technologies affecting the remedial action.

2.7.1 DRMO Open Trench Soil

Four alternatives were developed for detailed analysis in the feasibility study report for the DRMO Open Trench soil (Montgomery Watson, 1997). The remedial alternatives are:

- Alternative 1 - No Action
- Alternative 2 - SVE, Bioventing, and Excavation/Disposal
- Alternative 3 - SVE and Bioventing
- Alternative 4 - Excavation and Off-Site Disposal

2.7.1.1 Alternative 1 - No Action. The no-action alternative serves as a baseline for comparison with other alternatives. No remedial actions would be performed at the site. Because site contaminants would remain on site, the site would be reviewed every 5 years, as required under CERCLA. The total present-worth cost for this alternative is $70,000.

2.7.1.2 Alternative 2 - Soil Vapor Extraction, Bioventing, and Excavation/Disposal. This alternative utilizes SVE and bioventing to remediate the COCs in soil at the DRMO Open Trench. SVE removes volatile constituents from soil by inducing air flow through the soil using vacuum extraction vents installed in the vadose zone. Once VOC and SVOC concentrations in the extracted vapors reach de minimis levels, the SVE system will be converted to an in situ bioventing system by reversing the direction of air flow. Bioventing will utilize air injection to stimulate aerobic biodegradation of those constituents not removed via SVE. Both SVE and bioventing would be performed at the DRMO Open Trench by using air extraction/injection vents placed in the zone of soil contamination. It is assumed that extracted vapors from the DRMO Open Trench soil will be treated using a vapor-phase granular activated carbon (GAC) system consisting of 2,000-pound GAC canisters in series.

The first 5 feet of soil in the bottom of the trench (approximately 500 cubic yards or 750 tons) will be excavated and transported to an off-site facility for treatment and disposal following SVE/bioventing treatment. It is assumed that the soil will have to be incinerated prior to disposal given the high levels of contamination in the soil. Clean soil to fill the open trench to grade will be backfilled into the trench following SVE/bioventing treatment. All soil backfilled into the open trench will be compacted in a configuration to promote surface runoff away from the former trench. The total present-worth cost for this alternative is $2,775,000.

The SVE/bioventing treatment system will be operated to the extent technically and economically feasible and will at least attain the remediation levels discussed further in Section 2.8.1.1. As discussed in the FS (Montgomery Watson, 1997), the estimated mass of VOCs and SVOCs that is expected to be removed by the SVE/bioventing treatment system is approximately 7,000 pounds. Upon completion of SVE/bioventing treatment, confirmation sampling will be conducted. If the results of confirmation sampling show that cleanup levels have not been achieved, institutional controls may be implemented.

2.7.1.3 Alternative 3 - Soil Vapor Extraction and Bioventing. This alternative is similar to Alternative 2 in that it also utilizes SVE and bioventing to remediate the COCs in soil at the DRMO Open Trench Area. However, this alternative involves backfilling 10 feet of imported clean soil into the trench prior to SVE/bioventing treatment. All soil backfilled into the open trench will be compacted in a configuration to promote surface runoff away from the former trench. Backfilling will enable SVE and bioventing to treat the entire volume of soil in the trench with COCs above cleanup levels. It is assumed that extracted vapors from the DRMO Open Trench soil will be treated using a vapor-phase GAC system consisting of 2,000-pound GAC canisters in series. The total present-worth cost for this alternative is $1,588,000.

The SVE/bioventing treatment system will be operated to the extent technically and economically feasible and will at least attain the remediation levels discussed further in Section 2.8.1.1. As discussed in the FS (Montgomery Watson, 1997), the estimated mass of VOCs and SVOCs that is expected to be removed by SVE/bioventing treatment system is approximately 17,000 pounds. Upon completion of SVE/bioventing treatment, confirmation sampling will be conducted. If the results of confirmation sampling indicate that cleanup levels have not been achieved, institutional controls may be implemented.

2.7.1.4 Alternative 4 - Excavation and Off-Site Disposal. This alternative consists of excavating approximately 9,100 cubic yards (13,700 tons) of soil from the open trench. This volume includes approximately 1,500 cubic yards (2,200 tons) of contaminated soil and 7,200 cubic yards (10,800 tons) of excess soil from sloping the trench walls. The contaminated soil will be transported to a commercial off-site facility for treatment and disposal. It is assumed that the soil will be treated with incineration prior to disposal in an appropriately licensed landfill. The excess soil generated from sloping will be backfilled into the trench. Clean soil to replace the contaminated soil and to fill the open trench to grade will also be backfilled into the trench. The total present-worth cost for this alternative is $4,662,000.

2.7.2 Burn and Debris Area Soil

Two alternatives were developed for detailed analysis in the feasibility study report for the Burn and Debris Area (Montgomery Watson, 1997). The remedial alternatives are:

- Alternative 1 - No Action
- Alternative 2 - Excavation and Off-Site Disposal

2.7.2.1 Alternative 1 - No Action. The no-action alternative serves as a baseline for comparison with Alternative 2. No remedial actions would be performed at the Burn and Debris Area to eliminate future potential exposure pathways, and thus any risks to human health and the environment would not be reduced. Because soil contaminants would remain on site, the site would be reviewed every 5 years, as required under CERCLA. The total present-worth cost for this alternative is $70,000.

2.7.2.2 Alternative 2 - Excavation and Off-Site Disposal. This alternative consists of excavating approximately 700 cubic yards (1,100 tons) of soil and transporting it to a commercial off-site facility for treatment and disposal. It is assumed that the soil will require treatment for metals stabilization prior to Class I disposal. New soil would be backfilled, if necessary, onto the site, and compacted in a configuration to promote surface runoff away from the former trench. Additional characterization of the extent of contaminated soil prior to or during removal of the soil may reduce the volume to be excavated as well as the cost. The total present-worth cost for this alternative is $560,000.

2.7.3 DRMO Trench Area Groundwater

Three alternatives were developed for detailed analysis in the feasibility study report for the DRMO Trench Area groundwater (Montgomery Watson, 1997). The remedial alternatives are:

- Alternative 1 - No Action
- Alternative 2 - Natural Attenuation with Source Removal
- Alternative 3 - Groundwater Extraction and Treatment with GAC Adsorption

2.7.3.1 Alternative 1 - No Action. The no-action alternative serves as a baseline for comparison with other remedial alternatives. No remedial actions would be performed on the DRMO Trench Area groundwater to eliminate future potential exposure pathways, and thus any risks to human health and the environment would not be reduced. Groundwater monitoring would continue using the existing monitoring well network at the DRMO Trench Area on a semiannual basis for 5 years, then annually until year 30. As discussed previously, the maximum timeframe for the alternatives is assumed to be 30 years for the purpose of comparing alternatives. However, monitoring beyond 30 years may be required by the State if contaminants remain above remediation levels. Because contaminants would remain on site, the site would be reviewed every 5 years as required by CERCLA. The total present-worth cost for this alternative is $858,000.

2.7.3.2 Alternative 2 - Natural Attenuation with Source Removal. This alternative would utilize attenuation processes that naturally occur within the aquifer to decrease chemical concentrations and reduce migration of TCE to rates that are acceptable to the State of California. The site-specific hydrogeology is highly favorable for use of natural attenuation at the DRMO Trench Area. The contaminant plume beneath the site consists of relatively low concentrations of TCE (i.e., less than 150 μg/l). Due to hydrogeologic conditions (e.g., flat hydraulic gradients ranging from 0.0002 to 0.01 and low hydraulic conductivities), TCE in groundwater moves at a slow rate. The natural attenuation with source removal alternative consists of:

- Source removal via SVE/bioventing treatment of DRMO Open Trench soils (as described in Section 2.7.1.3)

- Installation of additional monitoring wells to complete the groundwater monitoring network

- Evaluation of natural attenuation of TCE in groundwater

- Source removal of TCE soil gas hot spot at the DRMO Active Yard via SVE treatment

Additional monitoring wells would be required to complete the groundwater monitoring network at the site. The FS assumes that two additional monitoring wells are needed. Additional wells may need to be installed over time as agreed by the Army and State due to plume migration or loss of existing wells. The FS assumes that groundwater monitoring would be conducted at 10 existing monitoring wells at the DRMO Trench Area along with two new monitoring wells. In addition to concentrations of VOCs and SVOCs, groundwater monitoring will include measurement of chemical parameters to help evaluate attenuation and degradation, including dissolved oxygen, oxidation-reduction potential, and concentrations of alternate electron acceptors (Table 2-11). Groundwater sampling would be conducted quarterly for one year, then annually thereafter. Groundwater modeling may also be conducted, if warranted. Institutional controls would be utilized to restrict the use of groundwater at the site during long-term monitoring.

Specific details of the groundwater monitoring and evaluation program will be established in the RD/RA Phase and may be modified through the FFSRA without revision of this ROD/RAP. The Army will submit status reports on the results of groundwater monitoring to the State of California on a quarterly basis for the first year and then annually thereafter.

During the groundwater monitoring program, the Army and State of California will review all hydrogeologic and chemical data to determine whether further implementation of the natural attenuation with source removal alternative is appropriate. If the results of monitoring the natural attenuation of the TCE plume are not acceptable to either the Army or State of California, Alternative 2 will be discontinued and a contingency alternative will be implemented. The contingency alternative consists of groundwater extraction and treatment. In the event that the contingency alternative is implemented, discharge standards, including effluent limits and monitoring requirements, must be developed for the discharge of treated groundwater. If the discharge is onsite, the Army will work with the RWQCB who will develop substantive Waste Discharge Requirements. If the discharge is offsite, the RWQCB will issue Waste Discharge Requirements. Those substantive Waste Discharge Requirements will specify the appropriate effluent discharge standards, monitoring programs, and other relevant performance criteria.

However, the Army may propose a contingency alternative other than pump-and-treat. Upon agreement by the Army and State of California, the new contingency alternative will be evaluated and implemented. The Army will continue to periodically review the feasibility of natural attenuation and other potential remedial technologies.

Future site review activities will be conducted every 5 years pursuant to CERCLA §121(c) to assure that migration of the TCE plume is not impacting groundwater resources in the area. Institutional controls would restrict the use of groundwater at the site during the long-term groundwater monitoring.

Alternative 2 also includes remediation of soil within a localized area of the Active DRMO Yard where elevated levels of TCE in soil gas were detected (Figure 2-13). An SVE system will be constructed to remediate possible TCE in soil within the area of a soil gas anomaly. The soil remediation will eliminate the possibility that the elevated soil gas levels represent a point source for TCE in groundwater beneath the site. It is assumed that the SVE system will consist of installing one air extraction vent and two monitoring points but the actual system layout may be adjusted during design. The SVE treatment system will be operated to the extent technically and economically feasible and will at least attain the remediation levels discussed further in Section

TABLE 2-11

DRMO TRENCH AREA GROUNDWATER MONITORING PARAMETERS

Parameter	Rationale for Monitoring
Volatile Organic Compounds and Semivolatile Organic Compounds	Measure contaminant concentrations in aquifer.
Dissolved Oxygen (DO)	To determine if aerobic or anaerobic conditions prevail in groundwater.
Oxidation-Reduction Potential (Eh)	To determine if aerobic or anaerobic conditions prevail in groundwater.
Alternate Electron Acceptors (e.g., nitrate, sulfate/sulfide, iron III, carbonate, ammonia, phosphate, manganese)	The presence of alternate electron acceptors is necessary for anaerobic biodegradation.
Methane	Characteristic of anaerobic biodegradation through methanogenesis.
Conductivity (EC)	Field measurement that will help determine stability of groundwater prior to sampling.
pH	Field measurement that will help determine stability of groundwater prior to sampling as well as help determine if the groundwater is conducive to microbial activity.

2.8.1.1 for the DRMO Open Trench Soil. The total present-worth cost for this alternative is $1,060,000.

2.7.3.3 Alternative 3 - Groundwater Extraction and Treatment with GAC Adsorption. This alternative consists of extracting groundwater and treating it aboveground using GAC adsorption. With GAC adsorption, organic contaminants are removed from a water stream by passing the stream through a bed of activated carbon that adsorbs the organic compounds. It is assumed for costing purposes, that three extraction wells would be used to extract groundwater. It is also assumed that the liquid-phase GAC adsorption treatment system would consist of two carbon trains with three vessels in series. TCE in the extracted groundwater would continue to adsorb to the GAC until the adsorption sites on the carbon are occupied. Spent GAC media would be disposed of and replaced with fresh GAC media as needed.

It is assumed that two injection wells would be installed at the site to return treated water to the ground and enhance plume control. The proposed locations of these wells have been selected based on the assumption that treated groundwater from the nearby Building 210 Area site will be recharged to the aquifer. Institutional controls would be implemented at the site and the site would be reviewed every 5 years because contaminants would remain in groundwater for the duration of this alternative. To evaluate the effectiveness of the alternative, groundwater would be monitored using the existing well network on a semiannual basis for the first 5 years and then annually thereafter.

Soil remediation using SVE would be conducted within the DRMO Active Yard as described in Section 2.7.3.2. The total present-worth cost for Alternative 3 is $3,614,000.

2.8 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

The remedial alternatives developed for the DRMO Trench Area in the feasibility study were analyzed in detail using the nine evaluation criteria required by the NCP (40 CFR 300.430(e)(9)). These criteria are classified as threshold criteria, primary balancing criteria, and modifying criteria. Threshold criteria are:

(1) Overall protection of human health and the environment
(2) Compliance with ARARs

Primary balancing criteria are:

(3) Long-term effectiveness and permanence
(4) Reduction of toxicity, mobility, or volume through treatment
(5) Short-term effectiveness
(6) Implementability
(7) Cost

Modifying criteria are:

(8) State/support agency acceptance
(9) Community acceptance

The resulting strengths and weaknesses of the alternatives were then weighed to identify the alternative providing the best balance among the nine criteria. Figures 2-22 through 2-24 summarize this comparison for the DRMO Open Trench soil, the Burn and Debris Area soil, and the DRMO Trench Area groundwater.

2.8.1 Overall Protection of Human Health and the Environment

This criterion is an overall assessment of whether a remedy provides adequate protection of human health and the environment. The evaluation focuses on a determination of the degree to which a specific alternative achieves adequate protection and describes the manner in which site risks are eliminated, reduced, or controlled through treatment, engineering, or institutional measures. The potential for cross-media impacts is also assessed.

2.8.1.1 DRMO Open Trench Soil. The baseline risk assessment determined that potential cancer risks and noncancer health effects to current intermittent workers are acceptable according to current USEPA and DTSC guidelines (i.e., cancer risk $<10^{-4}$ and hazard index <1.0). Estimated noncancer health effects for the future construction workers and future adult residents are also considered acceptable according to current USEPA and DTSC guidelines. However, estimated cancer risks for potential future construction workers and noncancer health effects for potential future child residents are considered unacceptable. The baseline risk assessment concluded that the open trench soils pose minimal risk to ecological receptors due to the small areal extent of soil contamination.

In addition to the potential risks estimated by the baseline risk assessment, potential threats to groundwater posed by contaminants in the open trench soils were assessed in the feasibility study (Montgomery Watson, 1997). Several VOCs and SVOCs were determined to pose a threat to groundwater quality.

Proposed soil remediation levels for the COCs in soil at the DRMO Open Trench are listed in Table 2-12. Chlorobenzene, ethylbenzene, PCE, toluene, xylenes, and 1,2-dichlorobenzene in soil at the Open Trench pose a potential threat to groundwater but do not pose adverse health risks; thus, the proposed remediation levels for these chemicals are solely based on groundwater protection (Table 2-12). TCE poses both a threat to human receptors and groundwater beneficial uses. Thus, soil remediation levels for TCE based on both protecting human health and groundwater beneficial uses were calculated. The soil remediation level selected for TCE is the lower of the two levels (0.5 mg/kg). The remediation levels for all of the SVOCs (except 1,2-dichlorobenzene and 1,4-dichlorobenzene) in the Open Trench soil are based on mitigating risks to future adult residents. SESOIL vadose zone modeling predicted that 1,4-dichlorobenzene would not migrate to groundwater. However, groundwater monitoring conducted in September 1993 detected 1,4-dichlorobenzene at 53 μg/l. Thus, a soil remediation level based on

DRMO Open Trench Soil

ALTERNATIVE	PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT	COMPLIANCE WITH ARARS	EFFECTIIVE-NESS	REDUCTION OF TOXICITY, MOBILITY, AND VOLUME (TMV)	IMPLEMEN-TABILITY	TOTAL COST[a]	STATE ACCEPTANCE	COMMUNITY ACCEPTANCE
1 (NO ACTION)	Potential for Future Exposure Remains	Does Not Comply	Not Effective	No Reduction in TMV	No Technical Limitations	$70,000	No	No
2 (SVE, BIOVENTING, & EXCAVATION/ DISPOSAL	Potential for Future Exposure Is Significantly Reduced	Does Comply	Effective	Reduction in TMV	Easily Implemented	$2,775,000	Yes	Yes
3 (SVE & BIOVENTING)	Potential for Future Exposure Is Significantly Reduced	Does Comply	Effective	Reduction in TMV	Easily Implemented	$1,588,000	Yes	Yes
4 (EXCAVATION & OFF-SITE DISPOSAL)	Potential for Future Exposure Is Significantly Reduced	Does Comply	Effective	Reduction in TMV	Easily Implemented	$4,662,000	Yes	Yes

Preferred alternative is shaded.

a Based on 30-year present worth cost.

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SUMMARY OF ALTERNATIVES

DRMO OPEN TRENCH AREA

FIGURE 2-22

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Burn and Debris Soil

ALTERNATIVE	PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT	COMPLIANCE WITH ARARS	EFFECTIVE-NESS	REDUCTION OF TOXICITY, MOBILITY, AND VOLUME (TMV)	IMPLEMEN-TABILITY	TOTAL COST[a]	STATE ACCEPTANCE	COMMUNITY ACCEPTANCE
1 (NO ACTION	Potential for Future Exposure Remains	Does Not Comply	Not Effective	No Reduction in TMV	No Technical Limitations	$70,000	No	No
2 (EXCAVATION & OFF-SITE DISPOSAL)	**Potential for Future Exposure Is Significantly Reduced**	**Does Comply**	**Effective**	**Reduction in TMV**	**Easily Implemented**	**$560,000**	**Yes**	**Yes**

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SUMMARY OF ALTERNATIVES

BURN AND DEBRIS AREA

FIGURE 2-23

DRMO Trench Area Groundwater

ALTERNATIVE	PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT	COMPLIANCE WITH ARARS	EFFECTIIVE-NESS	REDUCTION OF TOXICITY, MOBILITY, AND VOLUME (TMV)	IMPLEMEN-TABILITY	TOTAL COST[a]	STATE ACCEPTANCE	COMMUNITY ACCEPTANCE
1 (NO ACTION	Potential for Future Exposure Remains	Does Not Comply	Not Effective	No Reduction in TMV[c]	No Technical Limitations	$858,000	No	No
2 (NATURAL ATTENUATION WITH SOURCE REMOVAL)	Potential for Future Exposure Is Reduced	Compliance is Achievable[b]	Effective	Reduction in TMV[c]	Easily Implemented	$1,102,000	Yes	Yes
3 (GROUNDWATER EXTRACTION & TREATMENT WITH GAC ADSORPTION)	Potential for Future Exposure Is Reduced	Compliance is Achievable	Effective	Reduction in TMV	Easily Implemented[d]	$3,614,000	Yes	Yes

Preferred alternative is shaded.

a Based on 30-year present worth cost.

b A groundwater monitoring network would be established to evaluate the rates of contaminant attenuation/degradation and migration.

c Reduction is TMV will depend on natural attenuation and degradation of contaminants.

d However, there may be difficulties with pump and treat due to site-specific hydrogeologic conditions, etc.

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SUMMARY OF ALTERNATIVES

DRMO TRENCH AREA GROUNDWATER

FIGURE 2-24

TABLE 2-12

SOIL REMEDIATION LEVELS
DRMO OPEN TRENCH SOIL

Constituent	Remediation Level (mg/kg)	Basis for Remediation Level
VOCs		
Chlorobenzene	7	Groundwater Protection
Ethylbenzene	70	Groundwater Protection
PCE	0.5	Groundwater Protection
TCE	0.5	Groundwater Protection
Toluene	15	Groundwater Protection
Xylenes	175	Groundwater Protection
SVOCs		
Benzo(a)anthracene	0.011[a]	Cancer Risk = 10^{-6}
Benzo(a)pyrene	0.014[a]	Cancer Risk = 10^{-6}
Benzo(b)fluoranthene	0.006[a]	Cancer Risk = 10^{-6}
Benzo(k)fluoranthene	0.009[a]	Cancer Risk = 10^{-6}
Chrysene	0.012[a]	Cancer Risk = 10^{-6}
1,2-Dichlorobenzene	60	Groundwater Protection
1,4-Dichlorobenzene	0.5	Groundwater Protection
Indeno(1,2,3-c,d)pyrene	0.009[a]	Cancer Risk = 10^{-6}
Metals		
Antimony	14.5[b]	Hazard Index = 1.0
Petroleum Hydrocarbons		
TPH-gasoline	100	Groundwater Protection
TPH-diesel	1,000	Groundwater Protection

[a] Applies only to surface soil because cleanup level is based on future adult resident scenario.
[b] Applies only to soils shallower than 2 feet because level is based on future child resident scenario.

groundwater protection was developed for 1,4-dichlorobenzene (Table 2-12). The remediation levels based on groundwater protection were calculated using the Designated Level Methodology developed by the Central Valley RWQCB (Central Valley RWQCB, 1996). Calculations for the soil remediation levels based on mitigating human health risks and groundwater protection are presented in the feasibility study (Montgomery Watson, 1997).

The Army proposes to remediate soils at the DRMO Open Trench to a remediation level of 1,000 milligrams per kilogram (mg/kg) for TPH-diesel and 100 mg/kg for TPH-gasoline. Remediation levels for petroleum hydrocarbons are based upon criteria in the Leaking Underground Fuel Tank (LUFT) guidance (SWRCB, 1989). The proposed remediation levels are TPH concentrations "that can be safely left in place without threatening groundwater quality" based upon an analysis of leaching potential. According to the leaching potential analysis, remediation levels for TPH-gas and TPH-diesel are 100 and 1,000 mg/kg, respectively, for sites where groundwater is at least 25 feet below the disposal area, such as the DRMO Open Trench. Based on the TPH cleanup levels, the majority of the petroleum hydrocarbon mass will be remediated.

Implementation of the no-action alternative (Alternative 1) would not reduce contaminant concentrations. Therefore, the potential for future exposure remains. Alternatives 2 through 4 would reduce contaminant concentrations thereby significantly reducing the potential for future exposure. Because the soils currently pose no risk to ecological receptors, all of the alternatives are considered to provide protection to the environment. Because soil contamination in the open trench currently poses a threat to groundwater, Alternatives 2 through 4 are considered protective of groundwater quality because the majority of the contaminant mass is expected to be removed. The soil remediation levels shown in Table 2-12 are considered protective of groundwater quality due to site-specific conditions. Groundwater is more than 90 feet below ground surface. Fine-grained layers, which act to retard the downward movement of chemicals in the soil, are present in the shallow subsurface beneath the site. Additionally, the site receives little precipitation and has relatively high rates of evaporation, which further inhibits the transport of chemicals downward through the soil column.

2.8.1.2 Burn and Debris Area Soil. The baseline risk assessment determined that potential noncancer health effects to current intermittent workers are acceptable according to current USEPA and DTSC guidelines. However, estimated cancer risks for current intermittent workers are considered unacceptable. Estimated cancer risks and noncancer health effects for potential future construction workers and potential future adult residents are considered unacceptable. Noncancer health effects for future child residents are also considered unacceptable. The baseline risk assessment concluded that the Burn and Debris Area soils pose minimal risk to ecological receptors due to the small areal extent of soil contamination.

In addition to the potential risks estimated by the baseline risk assessment, potential threats to groundwater posed by contaminants in the open trench soils were assessed in the feasibility study (Montgomery Watson, 1997). No soil contaminants were determined to pose a threat to groundwater quality.

Proposed remediation levels for the COCs in soil at the DRMO Burn and Debris Area (PCB-1260 and antimony) are listed in Table 2-13. The remediation level for PCB-1260 was

TABLE 2-13

SOIL REMEDIATION LEVELS
DRMO BURN AND DEBRIS AREA SOIL

Constituent	Remediation Level (mg/kg)	Basis for Remediation Level
PCBs		
PCB-1260	4.5[a]	Cancer Risk = 10^{-6}
Metals		
Antimony	30[b]	Hazard Index = 1.0

[a] Applies only to soil shallower than 12 feet bgs because level is based on a future construction worker scenario.

[b] Applies only to soil shallower than 2 feet bgs because level is based on a future child resident scenario.

determined based on mitigating risks to future construction workers; the remediation level for antimony is based on mitigating risks to future child residents. Calculations for the health-based remediation levels are presented in the feasibility study (Montgomery Watson, 1997). Because constituents detected in soil at the Burn and Debris Area do not threaten groundwater quality, remediation levels based on groundwater protection were not calculated.

Implementation of the no-action alternative (Alternative 1) would not reduce contaminant concentrations. Therefore, the potential for exposure under current and future exposure scenarios remains. The off-site treatment and disposal alternative (Alternative 2) would reduce contaminant concentrations thereby significantly reducing the potential for future exposure. Because the soils currently pose no risk to ecological receptors, all of the alternatives for the Burn and Debris Area soils are considered to provide protection to the environment. Additionally, soil contamination at the subsite currently does not pose a threat to groundwater; therefore, all of the alternatives are considered protective of groundwater quality. The soil remediation levels shown in Table 2-13 are considered protective of groundwater quality due to the site conditions. Groundwater is more than 90 feet below ground surface. Fine-grained layers, which act to retard the downward movement of chemicals in the soil, are present in the shallow subsurface beneath the site. Additionally, the site receives little precipitation and has relatively high rates of evaporation, which further inhibits the transport of chemicals downward through the soil column.

2.8.1.3 DRMO Trench Area Groundwater. There are no surface water bodies or other current potential exposure pathways for groundwater contamination at this site. The nearest water supply wells are SIAD's potable supply wells, which are approximately 0.5 miles southwest of the site. The baseline risk assessment determined that potential cancer risks and noncancer health effects to future residents exposed to groundwater are unacceptable according to current USEPA and State of California guidelines. Compounds contributing to these risks are arsenic and bis(2-ethylhexyl)phthalate. However, arsenic was not detected above background in any groundwater samples collected at the DRMO Trench Area. Therefore, all of the arsenic present in the groundwater is interpreted to be naturally occurring. Detections of bis(2-ethylhexyl)phthalate are interpreted to be a result of laboratory contamination. Although a future residential exposure scenario was considered for the DRMO Trench Area, the future resident is a highly unlikely scenario. Planned long-term land use for the site is storage and salvage of materials and supplies which will prohibit residential and agricultural development. SIAD is an active facility and there are currently no plans for closure at SIAD. In the event of closure, the Army will re-evaluate the site for proposed reuse.

Under California's State Water Resources Control Board (SWRCB) Resolution No. 68-16 (the state's Antidegradation Policy), water quality may not be allowed to be degraded to below what is necessary to protect beneficial uses. This resolution applies most often at CERCLA cleanups that involve extracting, treating, and discharging treated groundwater. Any activities that result in discharges to high quality water are required to use the best practicable treatment or method of control of the discharge necessary to avoid a pollution or nuisance and to maintain water quality. Best practicable treatment would take into account technical and economic feasibility.

The Army believes that SWRCB Resolution No. 68-16 is applicable to reinjection of treated effluent but does not consider it applicable to degradation of groundwater caused by plume movement at the DRMO Trench Area. The Army and the Lahontan RWQCB do not currently agree on the interpretation of SWRCB Resolution No. 68-16.

The Water Quality Control Plan for the Lahontan RWQCB ("Basin Plan") has designated groundwater at SIAD with the following beneficial uses: municipal and domestic supply, agricultural supply, industrial service supply, freshwater replenishment, and wildlife habitat (Lahontan RWQCB, 1995). These beneficial uses apply to all groundwater. Therefore, shallow groundwater, in addition to all other groundwater at SIAD, must be protected as a potential source of drinking water even though the shallow groundwater is not currently used for potable supply. The following narrative water quality objectives listed in the Basin Plan pertain to groundwater at SIAD:

"In ground waters designated as [municipal and domestic supply] MUN, the median concentration of coliform organisms over any seven-day period shall be less than 1.1/100 milliliters."

"Ground waters designated as MUN shall not contain concentrations of chemical constituents in excess of the maximum contaminant level (MCL) or secondary maximum contaminant level (SMCL) based upon drinking water standards specified in [CCR Title 22]..."

"Waters designated as [agricultural supply] AGR shall not contain concentrations of chemical constituents in amounts that adversely affect the water for beneficial uses (i.e., agricultural purposes)."

"Ground waters shall not contain concentrations of chemical constituents that adversely affect the water for beneficial uses."

"Ground waters designated as MUN shall not contain concentrations of radionuclides in excess of the limits specified in [CCR Title 22]..."

"Ground waters shall not contain taste or odor-producing substances in concentrations that cause nuisance or that adversely affect beneficial uses. For ground waters designated as MUN, at a minimum, concentrations shall not exceed adopted secondary maximum contaminant levels specified in [CCR Title 22]..."

SWRCB Resolution No. 92-49 requires that groundwater must be remediated in a manner that promotes attainment of background water quality or the best water quality which is reasonable if background concentrations cannot be achieved. If restoration to background water quality is technologically or economically infeasible, alternative cleanup levels can be established. Such alternative cleanup levels must (a) be consistent with the maximum benefit to the people of the state, (b) not unreasonably affect the present and anticipated beneficial uses of the water, (c) not result in water quality less than that prescribed in the Water Quality Control Plans and Policies adopted by the SWRCB and the Lahontan RWQCB, and (d) not exceed the lowest concentration that is technologically and economically achievable.

The Army agrees that SWRCB Resolution No. 92-49 requires the remediation of contaminated groundwater to the lowest levels that are technologically and economically feasible. Therefore, restoration of the groundwater to background concentrations will be considered by the Army to be a primary remedial objective of this ROD/RAP.

If during the implementation of the selected remedy, the Army believes that it is infeasible to meet the objective of remediation to background concentrations, the Army may demonstrate to the State that groundwater remediation to background is technologically or economically infeasible. To demonstrate remediation infeasibility, the Army shall submit a report which contains remediation data and other information supporting its claim. After the State receives the report, it will determine whether, or at what point, the Army may terminate its remediation efforts, or whether further remediation efforts are required. The TCE concentration of 5 μg/l specified in Table 2-14 is the concentration that would protect the waters for their beneficial uses, which is the minimum standard (i.e., highest allowable concentration) that would be protective of the applicable water quality objectives (i.e., "Protective Water Quality Objective" [PWQO]). However, to the extent consistent with State law and CERCLA Section 120(a)(4), the PWQO could be altered to a less stringent standard at a later date if cleanup to the PWQO is found to be technologically or economically infeasible. The PWQO for TCE is set at the federal and state MCLs because these levels are considered protective of groundwater beneficial uses.

Alternative 1 (no action) would not control exposure to groundwater or actively reduce groundwater contaminant concentrations. Therefore, the potential for future exposure to groundwater contamination remains. Because contaminated groundwater would not be available except through future installation of a supply well, the risk to environmental receptors is minimal at this site.

Alternative 2 would depend upon natural attenuation to reduce contaminant concentrations. Under Alternative 2, the deeper aquifer zones may be protected from future contamination because groundwater monitoring results indicate that contaminants from the "A" zone may not be migrating vertically. Furthermore, it is unlikely that the "A" zone of the aquifer will be used for water supply even without institutional controls in place. Potable supply wells installed at other areas of the basin are generally screened at depths greater than the "A" zone of the aquifer because of the poor quality of the "A" zone water. The potable supply wells currently installed at SIAD are screened from approximately 150 to 650 feet bgs. As with Alternative 1, the potential risks to ecological receptors are expected to be minimal for Alternative 2.

The pump-and-treat alternative (Alternative 3) involves active treatment of the groundwater. Therefore, this alternative could potentially reduce contaminant concentrations to below the PWQO for TCE thereby significantly reducing potential future exposure. However, the limitations of pump-and-treat systems are discussed in the following USEPA report: Guidance for Evaluating the Technical Impracticability of Ground-Water Restoration (USEPA, 1993). In this report, the USEPA states: "While both programs [Superfund and RCRA Corrective Action] have had a great deal of success reducing the immediate threats posed by contaminated groundwaters, experience over the past decade has shown that restoration to drinking water quality (or more stringent levels where required) may not always be achievable due to the

TABLE 2-14

PROTECTIVE WATER QUALITY OBJECTIVES
DRMO TRENCH AREA

Constituent	Protective Water Quality Objective (μg/l)	Basis for Protective Water Quality Objective
TCE	5	USEPA and California Primary MCL

μg/l - micrograms per liter

limitations of available remediation technologies." Hydrogeologic factors such as low hydraulic conductivities and the tendency of some contaminants to strongly sorb to soil are examples of limitations to pump-and-treat.

2.8.2 Compliance with Applicable or Relevant and Appropriate Requirements

SIAD is not on the National Priorities List (NPL). Pursuant to CERCLA §120(a)(4), remedial actions at non-NPL sites must comply with all state laws regarding remedial actions. Further, the Army, as the lead agency, must select a remedial action which complies with CERCLA §121(d)(1). Pursuant to CERCLA §121(d)(1), remedial actions must attain a degree of cleanup that assures protection of human health and the environment. Additionally, remedial actions that leave hazardous substances, pollutants, or contaminants on site must meet standards, requirements, limitations, or criteria that are ARARs.

Applicable requirements are those cleanup standards, control standards, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location or other circumstances at a CERCLA site.

Relevant and appropriate requirements are defined as those cleanup standards of control and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that although not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location or other circumstance at a CERCLA site, indicate that their use is well-suited to the particular site. If no ARAR addresses a particular situation, or if an ARAR is insufficient to protect human health or the environment, then non-promulgated standards, criteria, guidance, and advisories may be used to provide a protective remedy.

To the extent consistent with CERCLA and the NCP, the Army is not required to obtain federal, state, or local permits for those portions of the remedial actions conducted entirely on site, but need only comply with the substantive, not procedural, provisions which would have been included in any such permit.

CERCLA §121 states that, at the completion of a remedial action, a level or standard of control required by an ARAR will be attained for wastes that remain on site. In addition, the NCP, 40 CFR 300.435(b)(2), requires compliance with ARARs during the course of the remedial design/remedial action.

ARARs are identified on a site-specific basis from information about specific chemicals at the site, specific actions that are being considered as remedies, and specific features of the site location. There are three types of ARARs:

- Chemical-specific ARARs are health- or risk-based numerical values or methodologies that, when applied to site-specific conditions, result in the establishment of numerical values. These values establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment. If a chemical has more than one ARAR, the most stringent value will be complied with.

- Location-specific ARARs are restrictions placed on the concentration of a chemical or the activities to be conducted solely because they are in a specific location. Examples of special locations possibly requiring location-specific restrictions include floodplains, wetlands, historic places, and sensitive ecosystems or habitats.

- Action-specific ARARs are usually technology- or activity-based restrictions or requirements for remedial actions. These ARARs do not determine the remedial alternative to be applied at a site; rather, they indicate how a selected alternative will be implemented. The potential action-specific ARARs will vary depending on the remedial alternatives selected for the sites.

Where no standards exist for a given chemical or situation, nonpromulgated advisories and guidance issued by the state or federal government programs may represent "to be considered" (TBC) criteria or guidelines in the RI/FS process. Although TBC requirements are not legally binding, they may be evaluated along with ARARs as part of the risk assessment to establish protective target cleanup levels.

The following sections discuss the ARARs that were considered for the DRMO Open Trench soil, Burn and Debris Area soil, and DRMO Trench Area groundwater. A listing of federal and state laws that are ARARs is provided in Tables 2-15 and 2-16.

2.8.2.1 DRMO Open Trench Soil

Chemical-Specific ARARs. The Army has not identified any state or federal chemical-specific ARARs for any of the COCs detected in soil at the DRMO Open Trench.

Location-Specific ARARs. The Army has not identified any state or federal location-specific ARARs for the DRMO Open Trench.

Action-Specific ARARs. 23 CCR Division 3 contains regulations adopted by the SWRCB for the purpose of implementing certain provisions of the California Water Code. Chapter 15 of 23 CCR Division 3 ("Chapter 15") contains regulations governing discharges of waste to land where water quality could be adversely impacted. Chapter 15 regulations govern the discharge of waste to land for treatment, storage, and disposal and establish siting, containment, monitoring, and closure standards. Activities included in this program are the issuance of waste discharge requirements (WDRs) by the RWQCBs for the discharge of hazardous, designated, and nonhazardous solid wastes to land and the oversight of corrective actions at leaking waste management units. Cleanup activities involving the discharge of waste to land or the closure of leaking waste management units at a CERCLA site would be subject to the substantive requirements of Chapter 15. SWRCB Resolution No. 92-49 requires actions to clean up discharges of waste to comply with Chapter 15. Therefore, corrective action, closure, and other

TABLE 2-15

APPLICABLE OR RELEVANT AND APPROPRIATE FEDERAL REQUIREMENTS FOR SIAD

Standard, Requirement, Criterion, or Limitation	Citation	Description	Applicable or Relevant and Appropriate	Comment
Action-Specific				
Occupational Safety and Health Act	29 U.S.C. §§651-678	Regulates worker health and safety.	Applicable	Under 40 CFR '300.38, requirements of the Act apply to all response activities under the NCP.

TABLE 2-16

APPLICABLE OR RELEVANT AND APPROPRIATE CALIFORNIA REQUIREMENTS FOR SIAD
(Page 1 of 5)

Standard, Requirement, Criterion, or Limitation	Citation	Description	Applicable or Relevant and Appropriate	Comment
Action-Specific Mulford-Carrell Air Resources Act	H & S Code, Div. 26, §39000 et seq. CCR, Title 17, Part III, Chapter 1, §60000 et seq.	Regulates both nonvehicular and vehicular sources of air contaminants in California. Defines relationships of the California Air Resources Board (ARB) and local or regional air pollution control districts (APCDs). Establishes emission limitations.	Applicable	The local APCD sets allowable emission limits. Emission limits will need to be established for emissions associated with specific remedial alternatives. SIAD is located in Lassen County. Applicable air quality regulations are specified in the Lassen County Air Pollution Control District's Air Pollution Regulations. The Lassen County APCD determines emission limits on a site-specific basis. CA Regulatory Agency: ARB; Lassen County APCD
Hazardous Waste Control Laws	H & S Code, Div. 20, Chapters 6.5 and 6.8, §25100 et seq. CCR Title 22, Div. 4.5, Chapter 10, §66001 et seq.	Regulations governing hazardous waste control; management and control of hazardous waste facilities; transportation; laboratories; classification of extremely hazardous, hazardous, and nonhazardous waste. Includes STLCs and TTLCs.	Applicable	State hazardous waste control laws are considered applicable or relevant and appropriate operating standards for those alternatives involving treatment and disposal of hazardous wastes. CA Regulatory Agency: Department of Toxic Substances Control (DTSC).
Identification and Listing of Hazardous Waste (Hazardous Substance Act)	CCR, Title 22, Div. 4.5, Chapter 11, §66261 et seq.	Definitions and characteristics of waste, hazardous waste, RCRA hazardous waste and special waste. Labeling requirements.	Applicable	This Act applies to ongoing operations of a facility that processes hazardous materials or wastes. CA Regulatory Agency: DTSC

TABLE 2-16

APPLICABLE OR RELEVANT AND APPROPRIATE CALIFORNIA REQUIREMENTS FOR SIAD

Standard, Requirement, Criterion, or Limitation	Citation	Description	Applicable or Relevant and Appropriate	Comment
Health and Safety Standards for Management of Hazardous Waste	CCR, Title 22, Div. 4.5, Chapt. 14, Art. 16, §§66264.600-66264.603	Applies to owners and operators of facilities that treat, store or dispose of RCRA hazardous waste in miscellaneous units. Covers environmental performance standards, monitoring, inspections, and post-closure care.	Applicable	Some of the alternatives will utilize treatment systems that are considered miscellaneous units. CA Regulatory Agency: DTSC
	CCR, Title 22, Div. 4.5, Chapt. 14, Art. 9, §§66264.170-66264.178	Applies to owners and operators who store hazardous waste for more than 90 days in containers. Covers use and management of containers, containment, inspections, and closure.	Relevant and Appropriate	CA Regulatory Agency: DTSC
Porter-Cologne Water Quality Control Act	California Constitution, Article X. Water Sec. 2. Water Resource. California Water Code: Div. 1, Chapt. 2.5, Art. 3; Div. 7, Chapt. 1, 2; Chapt. 3, Art. 3; Chapt. 3, Art. 4, §§13160, 13170, 13170.1, 13170.2, 13172; Chapt. 4, Art. 2, §§13225, 13226, 13227; Chapt. 4, Art. 3, §§13240, 13241, 13242, 13243, 13247; Chapt. 4, Art. 4, §§13260, 13261, 13263, 13265, 13267, 13268, 13273, 13273.2, 13273.3; Chapt. 5, Art. 1, §§13301, 13304; Chapt. 5, Art. 1, §§13301, 13304; Chapt. 5, Art. 6, §13360; Chapt. 5.5	Authorizes the State and Regional Water Boards to establish in Water Quality Control Plans beneficial uses and numerical and narrative standards to protect both surface and groundwater quality. Authorizes Regional Water Boards to issue permits for discharges to land or surface or groundwater that could affect water quality, including National Pollution Discharge Elimination System (NPDES) permits, and to take enforcement action to protect water quality. Implemented through regulations (Title 23 CCR), plans, policies and guidelines.	Applicable	The RWQCB will determine specific cleanup standards. The RWQCB will identify any other promulgated requirements which apply to the proposed remedial alternatives. CA Regulatory Agency: RWQCB; State Water Resources Control Board

TABLE 2-16

APPLICABLE OR RELEVANT AND APPROPRIATE CALIFORNIA REQUIREMENTS FOR SIAD

Standard, Requirement, Criterion, or Limitation	Citation	Description	Applicable or Relevant and Appropriate	Comment
Water Quality Control Plans	Water Code, Div. 7, §13140, §3240	Each Regional Board promulgates and administers a Water Quality Control Plan for ground and surface water basin(s) within its region. The State Board also promulgates state-wide water quality control plans that the regional boards administer. The Plans establish water quality standards (including beneficial use designations, water quality objectives to protect those uses, and implementation programs to meet the objectives) that apply statewide or to specific water basins.	Applicable	Regional Water Quality Objectives are identified in the Water Quality Control Plan Reports (Basin Plans) of the nine RWQCBs. Used to set discharge standards for NPDES permits and Waste Discharge Requirements (WDRs). These criteria may be applicable depending on the remedial alternative chosen. CA Regulatory Agency: RWQCB, State Water Resources Control Board
Water Quality Protection Standards	CCR, Title 23, Division 3, Chapter 15, Article 5, §2550.12	Establishes water quality protection standards including concentration limits for constituents of concern at background levels. Cleanup levels above background must meet all applicable water quality standards and must be the lowest levels technologically and economically achievable. Corrective action programs are required to achieve compliance with the water quality protection standards.	Applicable	As determined by RWQCB CA Regulatory Agency: RWQCB; State Water Resources Control Board
Porter-Cologne Water Quality Control Act (California Water Code Sections 13140, 13240, 13260, 13263, 13267, 13300, 13304, 13307)	State Water Resources Control Board Resolution No. 92-49	Establishes requirements for investigation and cleanup and abatement of discharges. Among other requirements, dischargers must cleanup and abate the effects of discharges in a manner that promotes the attainment of either background water quality, or the best water quality that is reasonable if background water quality cannot be restored. Requires the application of Title 23, CCR, Division 3, Chapter 15 requirements to cleanups.	Applies to all cleanups of discharges that may affect water quality.	CA Regulatory Agency: RWQCB

TABLE 2-16

APPLICABLE OR RELEVANT AND APPROPRIATE CALIFORNIA REQUIREMENTS FOR SIAD
(Page 4 of 5)

Standard, Requirement, Criterion, or Limitation	Citation	Description	Applicable or Relevant and Appropriate	Comment
State Water Resources Control Board Antidegradation Policy	State Water Resources Control Board Resolution No. 68-16	The State Board's policy on maintaining the high quality of California's waters.	See comment	The RWQCB establishes aquifer cleanup levels and effluent treatment standards for groundwater based upon this policy. The Army believes that SWRCB Resolution 68-16 is applicable to reinjection of treated effluent but does not consider it applicable to degradation of groundwater caused by plume movement at the DRMO Trench Area. The Army and Lahontan RWQCB do not currently agree on this interpretation.
California Safe Drinking Water Act	H & S Code, Div. 5, Part 1, Chapter 7, §4010 et seq. CCR, Tilte 22,m Div. 4, Chapter 15, §64401 et seq.	Regulations governing public water systems. Drinking Water Quality Standards - MCLs, SMCLs. Requirements for water quality analysis and laboratories.	Relevant and appropriate	The act is legally applicable for an aquifer and associated distribution and pre-treatment system that is currently defined as a "public Water system." If an aquifer, and associated distribution and pretreatment system is only a potential "public water system," then the act is relevant and appropriate. MCLs are acceptable concentration limits from a "free flowing coldwater outlet of the ultimate user." To apply this standard as a cleanup level for groundwater means the law, and the standard, is relevant and appropriate. CA Regulatory Agency: DHS, Water Supply Branch

TABLE 2-16

APPLICABLE OR RELEVANT AND APPROPRIATE CALIFORNIA REQUIREMENTS FOR SIAD
(Page 5 of 5)

Standard, Requirement, Criterion, or Limitation	Citation	Description	Applicable or Relevant and Appropriate	Comment
Drinking Water source Definition	State Water Resources Control Board Resolution No. 88-63 (included in Water Quality Control Plan for RWQCB Lahontan Region)	Specifies that all ground and surface waters are existing or potential sources of drinking water unless total dissolved solids (TDS) are greater than 3,000 ppm, the well yield is less than 200 gpd from a single well or the groundwater is unreasonable to treat using Best Management Practices or best economically achievable treatment practices.	Applicable	CA Regulatory Agency: RWQCB; State Water Resources Control Board

requirements of Chapter 15 are applicable to CERCLA cleanups, not just to cleanups involving waste management units. Therefore, Chapter 15 is an ARAR for the DRMO Trench Area.

The Army believes that Chapter 15 is an action-specific ARAR for the ROD/RAP that applies to discharges of waste to land resulting from implementation of remedial alternatives. The cleanup levels proposed in this ROD/RAP are protective of water quality, human health, and ecological receptors and, therefore, satisfy the water quality requirements of Chapter 15.

California SWRCB Resolution No. 92-49 establishes policies and procedures for the oversight of investigations and cleanup and abatement activities resulting from discharges that affect or threaten water quality. However, the scope of Water Code §13304 is limited by §13304(f) which states, "This section [13304] does not impose any new liability for acts occurring before January 1, 1981, if the acts were not in violation of existing laws or regulations at the time they occurred." SWRCB Resolution No. 92-49 requires actions for cleanup and abatement to conform to SWRCB Resolution No. 68-16 and State and Regional Water Board Water Quality Control Plans (Basin Plans) and Policies. Cleanup levels are not required to be more stringent than background. Cleanup levels and effluent discharge limitations need not be identical for the same site. SWRCB Resolution No. 92-49 is considered an ARAR for SIAD.

Additional action-specific ARARs for all of the alternatives include state hazardous waste management regulations (CCR Title 22), and state and federal occupational health and safety regulations (Table 2-16).

To Be Considered Criteria. The health-based remediation levels that have been calculated for the DRMO Open Trench soils are TBCs. The Designated Level Methodology developed by the Central Valley RWQCB (Central Valley RWQCB, 1996) is a TBC for the soil remediation levels based on protection of groundwater quality.

Compliance with ARARs. Alternative 1 would not actively reduce chemical concentrations to below soil remediation levels. Alternatives 2, 3, and 4 would reduce chemical concentrations in soil to below remediation levels thereby reducing adverse exposure. Reduction of contaminant mass in soil would also protect groundwater beneficial uses.

2.8.2.2 Burn and Debris Area Soil

Chemical-Specific ARARs. The Army has not identified any state or federal chemical-specific ARARs for any of the COCs detected in soil at the Burn and Debris Area.

Location-Specific ARARs. The Army has not identified any state or federal location-specific ARARs for the Burn and Debris Area.

Action-Specific ARARs. Potential action-specific ARARs for all of the alternatives include waste discharge requirements (23 CCR Div. 3, Chapter 15), state hazardous waste management regulations (CCR Title 22), and state and federal occupational health and safety regulations

(Table 2-16). As discussed in Section 2.8.2.1, SWRCB Resolution No. 92-49 is an ARAR for SIAD.

To-Be-Considered Criteria. The health-based cleanup levels developed for soils at the Burn and Debris Area are TBCs.

Compliance with ARARs. Alternative 1 would not reduce soil contaminant concentrations to below remediation levels. Alternative 2 would utilize treatment to reduce contaminant concentrations to below remediation levels.

2.8.2.3 DRMO Trench Area Groundwater

Chemical-Specific ARARs. Under California's SWRCB Resolution No. 68-16 (the state's Antidegradation Policy), water quality may not be allowed to be degraded to below what is necessary to protect beneficial uses. This resolution applies most often at CERCLA cleanups that involve extracting, treating, and discharging treated groundwater. Any activities that result in discharges to high quality water are required to use the best practicable treatment or method of control of the discharge necessary to avoid a pollution or nuisance and to maintain water quality. Best practicable treatment would take into account technical and economic feasibility.

The Army believes that SWRCB Resolution No. 68-16 is applicable to reinjection of treated groundwater but does not consider it applicable to degradation of groundwater caused by plume movement at the DRMO Trench Area. The Army and the Lahontan RWQCB do not currently agree on this interpretation of SWRCB Resolution No. 68-16.

The Water Quality Control Plan for the Lahontan RWQCB ("Basin Plan") has designated groundwater at SIAD with the following beneficial uses: municipal and domestic supply, agricultural supply, and freshwater replenishment (Lahontan RWQCB, 1995). These beneficial uses apply to all groundwater. Therefore, shallow groundwater, in addition to all other groundwater, at SIAD must be protected as a potential source of drinking water even though the shallow groundwater is not currently used for potable supply. The following narrative water quality objectives listed in the Basin Plan pertain to groundwater at SIAD:

"In ground waters designated as [municipal and domestic supply] MUN, the median concentration of coliform organisms over any seven-day period shall be less than 1.1/100 milliliters."

"Ground waters designated as MUN shall not contain concentrations of chemical constituents in excess of the maximum contaminant level (MCL) or secondary maximum contaminant level (SMCL) based upon drinking water standards specified in [CCR Title 22]..."

"Waters designated as [agricultural supply] AGR shall not contain concentrations of chemical constituents in amounts that adversely affect the water for beneficial uses (i.e., agricultural purposes)."

"Ground waters shall not contain concentrations of chemical constituents that adversely affect the water for beneficial uses."

"Ground waters designated as MUN shall not contain concentrations of radionuclides in excess of the limits specified in [CCR Title 22]..."

"Ground waters shall not contain taste or odor-producing substances in concentrations that cause nuisance or that adversely affect beneficial uses. For ground waters designated as MUN, at a minimum, concentrations shall not exceed adopted secondary maximum contaminant levels specified in [CCR Title 22]..."

Location-Specific ARARs. The Army has not identified any state or federal location-specific ARARs for the DRMO Trench Area.

Action-Specific ARARs. As required by the California Porter-Cologne Water Quality Act, the Lahontan RWQCB defines the beneficial uses of various water bodies for the Herlong Hydrologic Subunit which includes SIAD. Water bodies and their beneficial uses are presented in the Basin Plan. The Basin Plan classifies aquifers at SIAD to have "existing or potential beneficial uses as sources of drinking water." The Basin Plan has been promulgated and portions thereof are ARARs with respect to SIAD. The identification of the beneficial use of the groundwater at SIAD serves as the basis for selection of maximum COC concentrations for cleanup of groundwater pursuant to SWRCB Resolution No. 92-49. As discussed in Section 2.8.1.3, SWRCB Resolution No. 92-49 requires that groundwater must be remediated to the lowest levels that are technologically and economically achievable. Therefore, restoration of the groundwater to background concentrations will be considered by the Army to be a primary remedial objective of this ROD/RAP. If during the implementation of the selected remedy, the Army believes that it is infeasible to meet the objective of remediation to background concentrations, the Army shall demonstrate to the State that groundwater remediation to background is technologically or economically infeasible. To demonstrate remediation infeasibility, the Army may submit a report which contains remediation data and other information supporting its claim. After the State receives the report, it will determine whether, or at what point, the Army may terminate its remediation efforts, or whether further remediation efforts are required.

Treatment ARARs:

Use of activated carbon for remediation of VOCs under Alternative 3 could trigger requirements associated with regeneration or disposal of the spent carbon. If the spent carbon is listed waste or a characteristic waste then it is regulated as a hazardous waste under California's Hazardous Waste Management (HWM) regulations (22 CCR §§66262.10 - 66262.57).

Containers used for storage of contaminated carbon that is classified as a listed or characteristic waste must comply with California HWM regulations (22 CCR §§66262.30 - 66262.33). Accumulation of hazardous waste on site for more than 90 days may trigger the requirements set forth in California HWM regulations (22 CCR §66264).

Disposal of contaminants can trigger California HWM land disposal restrictions. If land disposal restrictions are triggered, spent carbon would need to meet treatment standards and California HWM disposal regulations.

Discharge ARARs:

Surface water is not impacted as a result of groundwater contamination at SIAD and none of the alternatives include discharge to surface water. In the event that the contingency alternative is implemented, discharge standards, including effluent limits and monitoring requirements, must be developed for the discharge of the treated groundwater. If the discharge is onsite, the Army will work with the RWQCB who will develop substantive Waste Discharge Requirements. If the discharge is offsite, the RWQCB will issue Waste Discharge Requirements. Those substantive waste discharge requirements will be based on SWRCB Resolution No. 68-16, and specify the appropriate effluent discharge standards, monitoring programs, and other relevant performance criteria.

As shown in Table 2-16, nonvehicular sources of air contaminants in California are regulated under the Mulford-Carrell Air Resources Act. This Act defines the relationships of the California Air Resources Board and local or regional air pollution control districts (APCDs). According to the Lassen County APCD, a complete inventory of secondary air emissions will be required to determine if treatment of vapor emissions from an air stripper will be required at SIAD (Smith, 1994). However, it is anticipated that treatment of air emissions will not be required due to the small volume of VOCs expected to be generated. Therefore, treatment of air emissions was included in Alternative 4 as a conservative measure.

Additional action-specific ARARs for all of the alternatives include state and federal occupational health and safety regulations.

To Be Considered Criteria. There are no TBCs for the DRMO Trench Area groundwater.

Compliance with ARARs. Alternatives 1 and 2 would depend upon natural attenuation to reduce TCE concentrations to below the 5 µg/l remediation level. As discussed in Section 2.7.3.2, a groundwater monitoring network would be established to evaluate natural attenuation. The pump-and-treat alternative (Alternative 3) would utilize treatment to reduce contaminant concentrations to the remediation level for TCE.

2.8.3 Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence refers to the ability of a remedy to maintain reliable protection of human health and the environment over time. This criterion includes the consideration of residual risk and the adequacy and reliability of controls.

2.8.3.1 DRMO Open Trench Soil. The no-action alternative (Alternative 1) would not provide long-term effectiveness and permanence because contaminants would remain in soil.

Alternatives 2 and 3 would provide long-term effectiveness by removing the majority of the contaminants from the soil using SVE. In addition, Alternatives 2 and 3 would use bioventing to biodegrade those contaminants remaining after SVE treatment. Alternative 3 would also utilize excavation and off-site disposal for contaminants that could not be removed with SVE and bioventing. Alternative 4 (excavation and off-site disposal) would provide long-term effectiveness and permanence by removing soil contaminants. Long term is considered to begin when remediation levels are achieved: approximately 6 years for Alternatives 2 and 3, and less than 3 months for Alternative 4.

2.8.3.2 Burn and Debris Area. The no-action alternative (Alternative 1) would not provide long-term effectiveness and permanence because contaminants would remain in soil. Alternative 2 (excavation and off-site disposal) would provide long-term effectiveness and permanence by removing soil contaminants.

2.8.3.3 DRMO Trench Area Groundwater. Alternative 1 (no action) would not provide long-term effectiveness and permanence because contaminants would remain in groundwater without any institutional controls in place. It is anticipated that Alternative 2 will provide long-term effectiveness and permanence by using attenuation processes that naturally occur within the aquifer to decrease chemical concentrations and reduce migration of TCE to rates that are acceptable to the State of California. Additionally, institutional controls would be utilized to prevent future use of groundwater. Groundwater will be monitored regularly to ensure that the contaminant horizontal and vertical migration rates are acceptable, and the site would be reviewed every 5 years by the Army and regulatory agencies. If Alternative 2 is not adequate, a contingency alternative (groundwater extraction and treatment) will be implemented. The contingency alternative would provide long-term effectiveness and permanence by using active treatment to reduce groundwater contaminant concentrations.

2.8.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Reduction of toxicity, mobility, or volume through treatment refers to the preference for a remedy that uses treatment to reduce health hazards, contaminant migration, or quantity of contaminants at the site.

2.8.4.1 DRMO Open Trench Soil. Alternative 1 would not reduce the toxicity, mobility, or volume of contaminants through treatment because this alternative does not involve active treatment. Since Alternatives 2, 3, and 4 would involve active treatment, the toxicity, mobility, and volume of soil contaminants would be reduced.

2.8.4.2 Burn and Debris Area Soil. Alternative 1 would not reduce the toxicity, mobility, or volume of contaminants through treatment because this alternative does not involve active treatment. Since Alternative 2 would involve active treatment, the toxicity, mobility, and volume of soil contaminants would be reduced.

2.8.4.3 DRMO Trench Area Groundwater. Alternatives 1 and 2 would depend upon natural attenuation (not active treatment) to reduce the toxicity, mobility, or volume of groundwater contaminants. Alternative 3 (groundwater extraction and treatment with GAC adsorption) would involve active treatment to reduce the toxicity, mobility, and volume of groundwater contaminants.

2.8.5 Short-Term Effectiveness

Short-term effectiveness refers to the period of time needed to complete the remedy and any adverse impacts on human health and the environment that may be posed during the construction and implementation of the remedy.

2.8.5.1 DRMO Open Trench Soil. All of the alternatives are judged to offer a high degree of short-term effectiveness because of the lack of risk posed to the community and/or workers during the construction and implementation phase. The excavation and off-site disposal alternative (Alternative 4) is the only alternative that could potentially expose the community/workers by excavating contaminated soil for off-site treatment and disposal. Alternative 4 could also provide exposure to contaminants during transportation of the soils to an off-site facility. However, any potential threat posed by soil excavation and transportation could be readily controlled by using appropriate dust control measures. In addition, this alternative would be conducted over a short period of time, i.e., less than 3 months.

No adverse environmental impacts are anticipated from the construction and implementation of any of the alternatives.

2.8.5.2 Burn and Debris Area Soil. Both of the alternatives are judged to offer a high degree of short-term effectiveness because of the lack of risk posed to the community and/or workers during the construction and implementation phase. The excavation and off-site disposal alternative (Alternative 2) could potentially expose the community/workers by excavating contaminated soil for off-site treatment and disposal. Alternative 2 could also provide exposure to contaminants during transportation of the soils to an off-site facility. However, any potential threat posed by soil excavation and transportation could be readily controlled by using appropriate dust control measures.

No adverse environmental impacts are anticipated from the construction and implementation of either of the alternatives.

2.8.5.3 DRMO Trench Area Groundwater. All of the alternatives are judged to offer a high degree of short-term effectiveness because of the lack of risk posed to the community and/or workers during the construction and implementation phase. No adverse environmental impacts are anticipated from the construction and implementation of any of the alternatives.

2.8.6 Implementability

Implementability refers to the technical and administrative feasibility of a remedy, including availability of materials and services needed to implement the selected remedy. It also includes coordination of federal, state, and local governments in cleanup of the site.

2.8.6.1 DRMO Open Trench Soil. Although all of the alternatives considered in the detailed analysis are readily implementable, Alternative 1 offers the highest degree of implementability. For obvious reasons, Alternative 1 (no action) is easily implementable, requiring only soil monitoring.

Alternative 3 (soil vapor extraction and bioventing) would be slightly more difficult to implement because this alternative requires installation of an SVE/bioventing system which is relatively easy to construct and operate. Alternative 4 (excavation and off-site disposal) may also be more difficult to implement because this alternative requires excavation, sloping, and additional analyses to confirm that the excavated soil is not considered a hazardous waste. The most difficult alternative to implement is Alternative 2 (soil vapor extraction, bioventing, and excavation/disposal) because this alternative requires both soil excavation and well installation.

2.8.6.2 Burn and Debris Area Soil. Alternative 1 (no action) would be the easiest alternative to implement. However, this alternative would require long-term institutional management which would require administrative and regulatory participation. Alternative 2 (extraction and off-site disposal) would be more difficult to implement because this alternative requires excavation and additional analyses to confirm that the excavated soil is not considered a hazardous waste.

2.8.6.3 DRMO Trench Area Groundwater. Although all of the alternatives considered in the detailed analysis are readily implementable, Alternatives 1 and 2 offer the highest degree of implementability. For obvious reasons, Alternative 1 (no action) is easily implementable, requiring only groundwater monitoring. Alternative 2 (natural attenuation with source removal) would be slightly more difficult to implement because this alternative requires the installation of monitoring wells and groundwater sampling. The most difficult alternative to implement is Alternative 3 (groundwater extraction and treatment with GAC adsorption). This alternative would require aquifer pumping tests and refinement of the groundwater model prior to remedial design. In addition, this alternative would require installation of a groundwater extraction and GAC adsorption treatment system, installation of monitoring wells, off-site disposal of spent carbon from groundwater treatment, and periodic sampling of the treatment influent and effluent.

2.8.7 Cost

This criterion examines the estimated cost for each remedial alternative. For comparison, capital costs and annual operation and maintenance costs are used to calculate a present-worth cost for each alternative. A detailed cost analysis was performed for each of the alternatives proposed in the DRMO Trench Area FS report (Montgomery Watson, 1997). For comparison purposes, a 30-year project period was used to evaluate the alternatives, unless the restoration time frame was shorter. The actual project period will depend on the techniques employed coupled with periodic review and data analysis and conditions encountered during remediation.

The cost estimates for the alternatives have been developed for the purpose of comparing the alternatives. Specific cost elements are based on factors and a conceptual design and are not based on a detailed design. Consequently, the list of equipment may not be complete and the total estimated cost may not reflect actual costs incurred during the remediation project. Also, the estimated costs assume no changes in regulatory requirements and technologies affecting the remedial action.

The present-worth cost estimates of each alternative, assuming zero equipment salvage value, zero percent inflation, and a 7 percent discount rate, are shown for comparison in Figures 2-20 through 2-22.

2.8.7.1 DRMO Open Trench Soil. Alternative 1 is less costly and easier to implement than Alternative 3. However, this alternative does not satisfy the two threshold criteria. Alternatives 2 and 4 satisfy the two threshold criteria but would cost significantly more to implement than Alternative 3.

2.8.7.2 Burn and Debris Area Soil. Alternative 1 is less costly and easier to implement than Alternative 2. However, this alternative does not satisfy the two threshold criteria.

2.8.7.3 DRMO Trench Area Groundwater. Alternative 3 costs significantly more than Alternatives 1 and 2 because this alternative involves groundwater extraction and treatment. Alternative 2 (natural attenuation with source removal) costs less and satisfies the two threshold criteria.

2.8.8 State/Support Agency Acceptance

State acceptance indicates whether, based on its review of the RI/FS and proposed plan, the state in which the site resides agrees with the preferred alternative. The Army, as the lead agency in preparing the ROD/RAP, has involved DTSC and RWQCB. The Army has responded to all state regulatory agency comments received during their reviews of the RI/FS reports and proposed plan. The state regulatory agencies support the selection of the preferred remedies discussed in Section 2.9.

2.8.8.1 DRMO Open Trench Soil. The state regulatory agencies support the selection of Alternative 3 (soil vapor extraction and bioventing) as the preferred remedy. The state regulatory agencies also consider Alternatives 2 and 4 acceptable but do not consider Alternative 1 acceptable.

2.8.8.2 Burn and Debris Area Soil. The state regulatory agencies support the selection of Alternative 2 (excavation and off-site disposal) as the preferred remedy. The state regulatory agencies do not consider Alternative 1 acceptable.

2.8.8.3 DRMO Trench Area Groundwater. The state regulatory agencies support the selection of Alternative 2 (natural attenuation with source removal) as the preferred remedy. The state regulatory agencies also consider Alternative 3 acceptable but do not consider Alternative 1 acceptable.

2.8.9 Community Acceptance

Community acceptance indicates the public support of a given alternative. Section 3.0 of this ROD/RAP documents the community acceptance of the selected remedies, as presented in the proposed plan. Section 3.0 includes a responsiveness summary that addresses the oral comments received during the public comment period. No written comments or questions were received during the public comment period. The community did not express any significant objections to the selected remedies during the public meeting or public comment period.

2.9 SELECTED REMEDIES

The selection of the various remedies is based on the comparative analysis of the alternatives presented in Section 2.8 and provides the best of trade-offs with respect to the nine evaluation criteria. The following subsections describe the conceptual engineering and operation and maintenance features of the selected remedies. The current conceptual design parameters are listed for indication purposes. The specific details will be determined during the remedial design phase and, therefore may be different than those listed and discussed. Such differences will not require a modification of this ROD/RAP, unless they result in a substantial modification of a selected remedy.

2.9.1 DRMO Open Trench Soil

The Army has selected Alternative 3 (SVE and bioventing) as the remedy for the contaminated soil at the DRMO Open Trench. Based on information obtained during remedial investigations and on a careful analysis of all remedial alternatives, the State of California concurs with the selected remedy.

2.9.1.1 Description. This alternative uses two cleanup methods (SVE and bioventing) to remediate the contaminants in soil. The treatment system would be switched from SVE to bioventing when VOC concentrations in extracted vapors reach de minimus levels that are agreeable to the Army and State of California. This alternative involves backfilling 10 feet of imported clean soil into the trench prior to SVE/bioventing treatment. Backfilling would prevent rapid air exchange between the extraction/injection system and the atmosphere. Backfilling would also enable SVE and bioventing to treat the entire volume of soil from the bottom of the trench to 15 feet below the bottom of the trench, without having to excavate and remove any soil.

2.9.1.2 Estimated Costs. Costs for the SVE and bioventing alternative include site preparation and backfilling of the open trench, and capital and operating costs for the SVE/bioventing system. The total present-worth cost for this alternative is $1.6 million. Cost for Alternative 3 are summarized in Table 2-17.

2.9.2 Burn and Debris Area Soil

The Army has selected Alternative 2 (excavation and off-site disposal) as the remedy for the contaminated soil at the Burn and Debris Area soil. Based on information obtained during

TABLE 2-17

ESTIMATED COST FOR ALTERNATIVE DMO(SO)-3
SOIL VAPOR EXTRACTION AND BIOVENTING
DRMO OPEN TRENCH SOIL
SIERRA ARMY DEPOT

(Page 1 of 2)

Item/Description	Unit	Unit Cost	Quantity	Subtotal (a)	Total
Equipment Costs (EC)					
Collection Piping	linear foot	$20	300	$6,000	
Blower System	lump sum	$10,000	1	$10,000	
Gauges, Valves, etc.	lump sum	$8,000	1	$8,000	
			Subtotal EC	$24,000	
Construction Costs					
Construction Trailer (rental)	month	$500	1	$500	
Mobilization/Demobilization	lump sum	$3,000	1	$3,000	
Equipment Pad	each	$2,500	1	$2,500	
Backfilling and Compaction (b)	cubic yard	$28	3,300	$92,400	
Well Construction		Itemized in Table C-4		$26,000	
Health and Safety Plan	lump sum	$5,000	1	$5,000	
Vapor-Phase Treatment System	lump sum	$17,400	1	$17,400	
Mechanical		20% of EC		$4,800	
Instrumentation		10% of EC		$2,400	
Electrical		20% of EC		$4,800	
			Subtotal	$158,800	
TOTAL CAPITAL COST					$182,800
Operation and Maintenance (SVE) (c)					
Energy	kw-hr	$0.10	140,000	$14,000	
Labor	man-year	$75,000	1	$75,000	
Maintenance Materials	lump sum	$2,000	1	$2,000	
Vapor-Phase Treatment	lump sum	$140,000	1	$140,000	
Sampling and Analysis of Vapor (d)	each	$200	12	$2,400	
TOTAL ANNUAL O&M COST				$233,400	
NET PRESENT WORTH OF SVE O&M COSTS (2 YEARS, 7% DISCOUNT RATE)					$452,000

TABLE 2-17

ESTIMATED COST FOR ALTERNATIVE DMO(SO)-3
SOIL VAPOR EXTRACTION AND BIOVENTING
DRMO OPEN TRENCH SOIL
SIERRA ARMY DEPOT

Item/Description	Unit	Unit Cost	Quantity	Subtotal (a)	Total
Operation and Maintenance (Bioventing) (e)					
Energy	kw-hr	$0.10	10,000	$1,000	
Labor	man-year	$75,000	1	$75,000	
Maintenance Materials	lump sum	$2,000	1	$2,000	
Respiration Testing	each	$5,000	2	$10,000	
TOTAL ANNUAL O&M COST				$88,000	
NET PRESENT WORTH OF BIOVENTING O&M COSTS (4 YEARS, 7% DISCOUNT RATE)					$279,000
CAPITAL COST SUBTOTAL					**$182,800**
OPERATING COST SUBTOTAL (NET PRESENT WORTH)					**$731,000**
Plan and Specification Preparation (6% of Capital Costs, or $25,000, whichever is greater)					$25,000
Non-Design Engineering (4% of Capital Costs or $15,000, whichever is greater)					$15,000
Office Engineering During Construction (2% of Capital Costs)					$3,700
Construction Management (9% of Capital Costs)					$16,500
Final O&M Manuals (1% of Capital Costs)					$1,800
Contingency (30% of Operating and Capital Costs)					$274,100
Project Administration (17% of Operating and Capital Costs)					$155,300
Contractor's Overhead and Profit (20% of Operating and Capital Costs)					$182,800
TOTAL COST OF REMEDIAL ALTERNATIVE (f)					**$1,588,000**

Assumptions:
(a) Individual costs are rounded to the nearest one hundred dollars.
(b) Based on volume of soil needed to fill open trench. See Appendix B for volume calculations.
(c) Based on 2 years of operation. Vapor-phase treatment costs include monthly rent and GAC change out fees.
(d) Assume 12 vapor samples collected per year; each sample will be analyzed for VOCs (TO-14 analysis).
(e) Based on 4 years of operation.
(f) Total cost is rounded to the nearest one thousand dollars.

remedial investigations and on a careful analysis of all remedial alternatives, the State of California concurs with the selected remedy.

2.9.2.1 Description. This alternative consists of excavating approximately 700 cubic yards (1,100 tons) of soil from the Burn and Debris Area and transporting it to a commercial off-site facility for treatment and disposal. Given the levels of copper and lead detected in soil at the Burn and Debris Area, it is assumed that the soil would require treatment for metals stabilization prior to disposal in an appropriate land disposal facility. Additional characterization of the extent of contaminated soil prior to or during removal of the soil may reduce the volume to be excavated as well as the cost. The site would be backfilled with clean soil where necessary to promote runoff of surface water.

2.9.2.2 Estimated Costs. Costs for the excavation and off-site disposal alternative include costs for soil excavation, transportation, and off-site treatment and disposal. The total present-worth cost for this alternative is $560,000. Costs for Alternative 2 are summarized in Table 2-18.

2.9.3 DRMO Trench Area Groundwater

The Army has selected Alternative 2 (natural attenuation with source removal) as the remedy for contaminated groundwater at the DRMO Trench Area. Based on information obtained during remedial investigations and on a careful analysis of all remedial alternatives, the State of California concurs with the selected remedy.

The site-specific hydrogeologic and land use conditions at the site are highly favorable for use of natural attenuation.

The contaminant plume beneath the DRMO Trench Area consists of relatively low concentrations of TCE in groundwater and is stable. Due to the hydrogeology of the aquifer (flat hydraulic gradients and low hydraulic conductivities), movement of groundwater contaminants occurs at a slow rate. The horizontal extent of the plume has been characterized through the installation and sampling of 11 monitoring wells, three piezometers, and collection of 12 additional groundwater samples by drive sampling. The vertical extent of the plume has been characterized by four cluster zone wells. Further characterization of the horizontal and vertical extent of the plume will be performed as part of the selected remedy. An extensive groundwater monitoring program included in the selected remedy will provide substantial data on changes in chemical concentrations and aquifer conditions. Monitoring of these changes over time will provide a basis for prediction of future plume concentrations and migration. In addition, implementation of the selected remedies for soil cleanup will remove potential sources of groundwater contamination and will prevent further degradation of water quality.

The DRMO Trench Area is a restricted access area of Sierra Army Depot protected by locked or guarded gates. The nearest water supply wells are approximately 0.5 miles southwest of the site. Institutional controls will prevent use of groundwater in the surrounding areas and prevent possible exposure. The area surrounding the DRMO Trench Area is used for warehousing

TABLE 2-18

ESTIMATED COST FOR
EXCAVATION AND DISPOSAL
DRMO BURN AND DEBRIS AREA SOIL
SIERRA ARMY DEPOT

Item/Description	Unit	Unit Cost	Quantity	Subtotal (a)	Total
Soil Excavation					
Site Work Plan	lump sum	$15,000	1	$15,000	
Engineering Oversight (b)	hour	$130	12	$1,600	
Health and Safety Plan	lump sum	$5,000	1	$5,000	
Mobilization & Demobilization	lump sum	$4,000	1	$4,000	
Site Clearing	square foot	$0.20	2,400	$500	
Excavation (c)	cubic yard	$15	700	$10,500	
TOTAL CAPITAL COST					$36,600
Post Excavation Sampling (d)					
Sampling					
Personnel	hour	$60	8	$500	
Sampling Equipment	lump sum	$500	1	$500	
Analyses	sample	$300	5	$1,500	
TOTAL CAPITAL COST					$2,500
Disposal					
Disposal Fee (e)	ton	$200	1,100	$220,000	
TOTAL CAPITAL COST					$220,000
Demobilization					
Imported Fill	cubic yard	$17	700	$11,900	
Backfilling & Compaction	cubic yard	$11	700	$7,700	
TOTAL CAPITAL COST					$19,600

TABLE 2-18

ESTIMATED COST FOR
EXCAVATION AND DISPOSAL
DRMO BURN AND DEBRIS AREA SOIL
SIERRA ARMY DEPOT

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Item/Description	Unit	Unit Cost	Quantity	Subtotal (a)	Total
Closure Report	lump sum	$12,000	1	$12,000	
TOTAL CAPITAL COST					$12,000
CAPITAL COST SUBTOTAL					**$290,700**
OPERATING COST SUBTOTAL (NET PRESENT WORTH) (f)					**$0**
Plan and Specification Preparation (6% of Capital Costs, or $25,000, whichever is greater)					$25,000
Non-Design Engineering (4% of Capital Costs or $15,000, whichever is greater)					$15,000
Office Engineering During Construction (2% of Capital Costs)					$5,800
Construction Management (9% of Capital Costs)					$26,200
Final O&M Manuals (1% of Capital Costs)					$2,900
Contingency (30% of Operating and Capital Costs)					$87,200
Project Administration (17% of Operating and Capital Costs)					$49,400
Contractor's Overhead and Profit (20% of ~~Operating~~ and Capital Costs)					$58,100 211500
TOTAL COST OF REMEDIAL ALTERNATIVE (g)					**$560,000**

Assumptions:
(a) Individual costs are rounded to the nearest one hundred dollars.
(b) Two-person crew (one senior and one professional), 1 days, 12-hour days.
(c) Excavation consists of one trench: 45'x60'x1'. It is assumed that shoring would not be required. See Appendix B for detailed soil volume calculations.
(d) Assume five samples collected and analyzed for PCB1260 and antimony.
(e) Price quoted by Laidlaw Environmental Services; Martinez, CA. Disposal fee includes transportation to Laidlaw's facility in Westmoreland, CA, metals stabilization, disposal in a Class I landfill, and local taxes.
(f) For this alternative it is assumed no operating costs are incurred after the remedial action is implemented.
(g) Total cost is rounded to the nearest one thousand dollars.

supplies. Future land use is not expected to change and is conducive to use of natural attenuation to protect water quality.

2.9.3.1 Description. This alternative would utilize attenuation processes that naturally occur within the aquifer to decrease chemical concentrations and reduce migration of TCE to rates that are acceptable to the State of California. The alternative consists of:

- Source removal via SVE/bioventing treatment of DRMO Open Trench soils (as described in Section 2.9.1)
- Installation of additional monitoring wells to complete the groundwater monitoring network
- Evaluation of natural attenuation of TCE in groundwater
- Source removal of TCE soil gas hot spot in DRMO Active Yard via SVE treatment

Additional monitoring wells would be required to complete the groundwater monitoring network at the site. The FS assumes that two additional wells are needed. These two additional wells are expected to adequately monitor the groundwater. Additional wells may need to be installed over time as agreed by the Army and State due to plume migration or loss of existing wells. The FS also assumes that groundwater monitoring would be conducted at 10 existing monitoring wells at the DRMO Trench Area along with the two new monitoring wells. An initial list of monitoring parameters and the rationale for monitoring those parameters is provided in Table 2-11. Groundwater sampling would be conducted quarterly for one year, than annually until the fifth year. Groundwater modeling may also be conducted, if warranted. Institutional controls would be utilized to restrict the use of groundwater at the site during long-term monitoring.

Specific details of the groundwater monitoring and evaluation program will be established in the RD/RA Phase and may be modified through the FFSRA without revision of this ROD/RAP. The Army will submit status reports on the results of groundwater monitoring to the State of California based on the following schedule:

- Quarterly the first year
- Annually thereafter

During the groundwater monitoring program, the Army and State of California will review all hydrogeologic and chemical data to determine whether further implementation of the natural attenuation with source removal alternative is appropriate. If the results of monitoring natural attenuation of the TCE plume are not acceptable to either the Army or State of California, Alternative 2 will be discontinued and a contingency alternative will be implemented. The contingency alternative consists of groundwater extraction and treatment. In the event that the contingency alternative is implemented, discharge standards, including effluent limits and monitoring requirements, must be developed for the discharge of treated groundwater. If the discharge is onsite, the Army will work with the RWQCB who will develop substantive Waste

Discharge Requirements. If the discharge is offsite, the RWQCB will issue Waste Discharge Requirements. Those substantive waste discharge requirements will specify the appropriate effluent discharge standards, monitoring programs, and other relevant performance criteria.

However, the Army may propose a contingency alternative other than pump-and-treat. Upon agreement by the Army and State of California, the new contingency alternative will be evaluated and implemented according to CERCLA procedures. The Army will continue to periodically review the feasibility of natural attenuation and other potential remedial technologies.

Future site review activities will be conducted every 5 years pursuant to CERCLA §121(c) to assure that migration of the TCE plume is not impacting groundwater resources in the area. Institutional controls would restrict the use of groundwater at the site during the long-term groundwater monitoring.

Alternative 2 also includes remediation of soil within a localized area of the Active DRMO Yard where elevated levels of TCE in soil gas were detected (Figure 2-13). An SVE system will be constructed to remediate possible TCE in soil within the area of a soil gas anomaly. The soil remediation will eliminate the possibility that the elevated soil gas levels represent a point source of TCE in groundwater beneath the site. It is assumed that the SVE system will consist of installing one air extraction vent and two soil gas monitoring points. However, the actual system layout may be adjusted during the design. The SVE treatment system will be operated to the extent technically and economically feasible and will at least attain the remediation levels discussed further in Section 2.8.1.1 for the DRMO Open Trench Soil.

2.9.3.2 Estimated Costs. Costs for the natural attenuation with source removal alternative include costs for site preparation and capital and operating costs for the groundwater monitoring system. The total present-worth cost for this alternative is $1.1 million. Costs for Alternative 2 are summarized in Table 2-19.

2.10 STATUTORY DETERMINATIONS

2.10.1 DRMO Open Trench Soil

The selected remedy satisfies the statutory requirements of CERCLA §121 and CERCLA §120(a)(4), as amended by SARA, in that the following mandates are attained:

- The selected remedy is protective of human health and the environment.
- The selected remedy complies with federal and state requirements that are applicable or relevant and appropriate to the remedial action.
- The selected remedy is cost effective.

TABLE 2-19

ESTIMATED COST FOR ALTERNATIVE DMO(GW)-2
NATURAL ATTENUATION WITH SOURCE REMOVAL
DRMO TRENCH AREA GROUNDWATER
SIERRA ARMY DEPOT

Item/Description	Unit	Unit Cost	Quantity	Subtotal (a)	Total
Field Costs					
Installation of Additional Monitoring Wells	lump sum	$24,000	1	$24,000	
Preparation of Monitoring Plan	lump sum	$10,000	1	$10,000	
SVE Treatment at DRMO Active Yard	lump sum	$86,000	1	$86,000	
TOTAL CAPITAL COST					$120,000
Operation and Maintenance					
Annual Groundwater Monitoring (years 0-1) (b)	event/yr	$31,000	4	$124,000	
Annual Groundwater Monitoring (years 1-30) (b)	event/yr	$31,000	1	$31,000	
NET PRESENT WORTH OF O&M COSTS (30 YEARS, 7% DISCOUNT RATE)					$505,000
CAPITAL COST SUBTOTAL					**$120,000**
OPERATING COST SUBTOTAL (NET PRESENT WORTH)					**$505,000**
Non-Design Engineering (4% of Capital Costs or $15,000, whichever is greater)					$15,000
Final O&M Manuals (1% of Capital Costs)					$1,200
Contingency (30% of Operating and Capital Costs)					$187,500
Project Administration (17% of Operating and Capital Costs)					$106,300
Contractor's Overhead and Profit (20% of Operating and Capital Costs)					$125,000
TOTAL COST OF REMEDIAL ALTERNATIVE (c)					**$1,060,000**

Assumptions:
(a) Individual costs are rounded to the nearest one hundred dollars.
(b) Monitoring costs are for 10 existing wells plus two proposed wells.
(c) Total cost is rounded to the nearest one thousand dollars.

- The selected remedy utilizes permanent solutions and alternative treatment technologies or resource recovery technologies, to the maximum extent practicable.

- The selected remedy satisfies the preference for treatment that reduces toxicity, mobility, and/or volume as a principal element.

The following sections describe how the selected remedy satisfies each of the statutory requirements described above.

2.10.1.1 Protection of Human Health and the Environment. The baseline risk assessment determined that potential cancer risks and noncancer health effects to current intermittent workers are acceptable according to current USEPA and DTSC guidelines. Estimated noncancer health effects for the future construction workers and future adult residents are also considered acceptable according to current USEPA and DTSC guidelines. However, estimated cancer risks for potential future construction workers and noncancer health effects for potential future child residents are considered unacceptable. The baseline risk assessment concluded that the open trench soils pose minimal risk to ecological receptors due to the small areal extent of soil contamination.

As discussed in Section 2.6.1.4, the magnitude of acceptable cancer risk relative to Superfund site remediation goals in the NCP generally ranges from 10^{-4} to 10^{-6} (one in one million) depending on the site, proposed usage, and chemicals of concern (USEPA, 1991). Within this range, the level of risk that is considered to be acceptable at a specific site is decided on a case-specific basis. The one-in-one-million level of risk (expressed as 10^{-6}) is often referred to as the *de minimus* level of risk. However, DTSC has not endorsed 10^{-6} as a universally acceptable level of risk.

Therefore, the objective for remediating soils is to reduce soil contaminant concentrations to below levels resulting in an aggregate cancer risk of less than 10^{-6} and noncancer hazard index of less than 1.0. As discussed in Section 2.8.1.1, health-based remediation levels (Table 2-12) have been calculated. Alternative 3, the selected remedy would significantly reduce contaminant concentrations in DRMO Open Trench soil.

Section 2.8.5 discussed the short-term effectiveness of the evaluated alternatives. The selected remedy will not pose unacceptable short-term risks to human health or to environment during implementation.

2.10.1.2 Compliance with Applicable or Relevant and Appropriate Requirements. The selected remedy of SVE and bioventing will comply with all applicable or relevant and appropriate chemical-, action-, and location-specific ARARs. The ARARs are presented below.

Chemical-Specific ARARs. None.

Location-Specific ARARs. None.

Action-Specific ARARs.

California requirements for discharges of waste to land in 23 CCR, Div. 3, Chapter 15, §2500 et seq.

California requirements for hazardous waste management in 22 CCR, Div. 4, Chapter 30, §66001 et seq.

California and federal requirements for occupational health and safety in Labor Code, Div. 5, §6300 et seq., and 29 USC §§651-678, respectively.

Regional Water Quality Objectives in the Water Quality Control Plan ("Basin Plan") for the Lahontan RWQCB.

Requirements for investigation, cleanup, and abatement of discharges in SWRCB Resolution No. 92-49.

Other Criteria, Advisories, or Guidance To Be Considered for this Remedial Action (TBCs). The health-based remediation levels developed for the DRMO Open Trench soil are TBCs. The Designated Level Methodology developed by the Central Valley RWQCB (Central Valley RWQCB, 1996) is a TBC for the soil remediation levels based on protection of groundwater quality.

2.10.1.3 Cost Effectiveness. The selected remedy, Alternative 3, utilizes cost effective treatment for the type and volume of contaminants present. Although Alternative 3 will cost more than the no-action alternative, this alternative will satisfy the regulatory preference for active treatment, when practicable (40 CFR 300.430 (a)(1)(iii)(A)).

2.10.1.4 Utilization of Permanent Solutions and Alternative Treatment (or Resource Recovery) Technologies to the Maximum Extent Practicable. Figure 2-22 summarizes the detailed analysis of the alternatives with respect to the CERCLA-mandated evaluation criteria and identifies the major trade-offs of the selected remedy. The selected remedy, Alternative 3, by actively treating the soil, satisfies the statutory preference to utilize permanent solutions and treatment technologies to the maximum extent practicable.

2.10.1.5 Preference for Treatment as a Principal Element. The selected remedy employs active treatment of the soil to reduce soil contaminant concentrations. Therefore, the CERCLA preference for treatment is satisfied by the selected remedy.

2.10.2 DRMO Burn and Debris Area

The selected remedy satisfies the statutory requirements of CERCLA §121 and CERCLA §120(a)(4), as amended by SARA, in that the following mandates are attained:

- The selected remedy is protective of human health and the environment.

- The selected remedy complies with federal and state requirements that are applicable or relevant and appropriate to the remedial action.

- The selected remedy is cost effective.

- The selected remedy utilizes permanent solutions and alternative treatment technologies or resource recovery technologies, to the maximum extent practicable.

- The selected remedy satisfies the preference for treatment that reduces toxicity, mobility, and/or volume as a principal element.

The following sections describe how the selected remedy satisfies each of the statutory requirements described above.

2.10.2.1 Protection of Human Health and the Environment. The baseline risk assessment determined that cancer risks for current intermittent workers are considered unacceptable. Estimated cancer risks and noncancer health effects for potential future construction workers and potential future adult residents are considered unacceptable. Noncancer health effects for future child residents are also considered unacceptable. The primary compounds contributing to these risks are PCB-1260 and arsenic. The baseline risk assessment also concluded that the contaminated soils at this subsite pose minimal risks to ecological receptors.

Therefore, the objective for remediating soils is to reduce soil contaminant concentrations to below levels resulting in an aggregate cancer risk of less than 10^{-6} and noncancer hazard index of less than 1.0. As discussed in Section 2.8.1.2, health-based remediation levels (Table 2-13) have been calculated. Alternative 2, the selected remedy would significantly reduce contaminant concentrations in Burn and Debris Area soil.

Section 2.8.5 discussed the short-term effectiveness of the evaluated alternatives. The selected remedy will not pose unacceptable short-term risks to human health or the environment during implementation.

2.10.2.2 Compliance with Applicable or Relevant and Appropriate Requirements. The selected remedy of excavation and off-site disposal will comply with all applicable or relevant and appropriate chemical-, action-, and location-specific ARARs. The ARARs are presented below.

Chemical-Specific ARARs. None.

Location-Specific ARARs. None.

Action-Specific ARARs.

California requirements for discharges of waste to land in 23 CCR, Div. 3, Chapter 15, §2500 et seq.

California requirements for hazardous waste management in 22 CCR, Div. 4, Chapter 30, §66001 et seq.

California and federal requirements for occupational health and safety in Labor Code, Div. 5, §6300 et seq., and 29 USC §§651-678, respectively.

Regional Water Quality Objectives in the Water Quality Control Plan ("Basin Plan") for the Lahontan RWQCB.

Requirements for investigation, cleanup, and abatement of discharges in SWRCB Resolution No. 92-49.

Other Criteria, Advisories, or Guidance To Be Considered for this Remedial Action (TBCs). The health-based remediation levels that have been calculated for soils are TBCs.

2.10.2.3 Cost Effectiveness. The selected remedy, Alternative 2, utilizes cost effective treatment for the type and volume of contaminants present. Although Alternative 2 will cost more than the no-action alternative, this alternative will satisfy the regulatory preference for active treatment, when practicable (40 CFR 300.430 (a)(1)(iii)(A)).iii)(A)). The selected remedy (Alternative 2) is cost effective.

2.10.2.4 Utilization of Permanent Solutions and Alternative Treatment (or Resource Recovery) Technologies to the Maximum Extent Practicable. Figure 2-23 summarizes the detailed analysis of the alternatives with respect to the CERCLA-mandated evaluation criteria and identifies the major trade-offs of the selected remedy. The selected remedy, Alternative 2, by actively treating the soil, satisfies the statutory preference to utilize permanent solutions and treatment technologies to the maximum extent practicable.

2.10.2.5 Preference for Treatment as a Principal Element. The selected remedy employs active treatment of the soil to reduce soil contaminant concentrations. Therefore, the CERCLA preference for treatment is satisfied by the selected remedy.

2.10.3 DRMO Trench Area Groundwater

The selected remedy and contingency alternative satisfy the statutory requirements of CERCLA §121 and CERCLA §120(a)(4), as amended by SARA, in that the following mandates are attained:

- The selected remedy with the contingency alternative is protective of human health and the environment.

- The selected remedy with the contingency alternative complies with federal and state requirements that are applicable or relevant and appropriate to the remedial action.

- The selected remedy with the contingency alternative is cost effective.

- The selected remedy with the contingency alternative utilizes permanent solutions and alternative treatment technologies or resource recovery technologies, to the maximum extent practicable.

- The selected remedy with the contingency alternative satisfies the preference for treatment that reduces toxicity, mobility, and/or volume as a principal element.

The following sections describe how the selected remedy satisfies each of the statutory requirements described above.

2.10.3.1 Protection of Human Health and the Environment. The baseline risk assessment determined that potential cancer risks and noncancer health effects to future residents exposed to groundwater are unacceptable according to current USEPA and State of California guidelines. Compounds contributing to these risks are arsenic and bis(2-ethylhexyl)phthalate. However, arsenic was not detected above background in any groundwater samples collected at the DRMO Trench Area. Therefore, all of the arsenic present in the groundwater is naturally occurring. Detections of bis(2-ethylhexyl)phthalate are interpreted to be a result of laboratory contamination.

As discussed in Section 2.8.1.3, SWRCB Resolution No. 92-49 requires that groundwater must be remediated in a manner that promotes attainment of background water quality or the best water quality that is reasonable if background concentrations cannot be achieved. The future use of the groundwater at this site is highly unlikely given the planned long-term land use of the site. The planned long-term future use of the site is storage and salvage of materials and supplies which will prohibit residential and agricultural development. If these land uses change, other institutional controls may be considered. Therefore, the remedial objectives for DRMO Trench Area groundwater are to allow natural attenuation to prevent further groundwater contamination, and provide a long-term reduction in contaminant levels to attempt to restore background concentrations to protect human health and the environment. Alternative 2, the selected remedy would involve further characterization of the hydrogeology of the site, evaluation of natural attenuation, installation of additional groundwater monitoring wells, and institutional controls to prevent use of groundwater at the site. A groundwater monitoring network would be used to evaluate compliance. If the apparent rates of natural attenuation are not acceptable, the contingency alternative (groundwater extraction and treatment) will be implemented.

Section 2.8.5 discussed the short-term effectiveness of the evaluated alternatives. The selected remedy and contingency alternative will not pose unacceptable short-term risks to human health or the environment during implementation.

2.10.3.2 Compliance with Applicable or Relevant and Appropriate Requirements. The selected remedy and contingency alternative will comply with all applicable or relevant and appropriate chemical-, action-, and location-specific ARARs. The ARARs are presented below.

Chemical-Specific ARARs. As discussed in Section 2.8.1.3, water quality objectives presented in the Basin Plan have been used to develop the protective water quality objective for TCE presented in Table 2-14. The PWQO of 5 μg/l for TCE is set at the federal and state MCLs because these levels are considered protective of groundwater beneficial uses. The selected remedy would depend upon natural attenuation processes acting over a long period of time to reduce groundwater contaminant concentrations. The contingency alternative would use groundwater extraction and treatment to reduce contaminant concentrations.

Location-Specific ARARs. None.

Action-Specific ARARs.

California requirements for discharges of waste to land in 23 CCR, Div. 3, Chapter 15, §2500 et seq.

California requirements for hazardous waste management in 22 CCR, Div. 4, Chapter 30, §66001 et seq.

California and federal requirements for occupational health and safety in Labor Code, Div. 5, §6300 et seq., and 29 USC §§651-678, respectively.

Selected provisions of the Porter-Cologne Water Quality Act (California Water Code).

Regional Water Quality Objectives in the Water Quality Control Plan ("Basin Plan") for the Lahontan RWQCB.

Requirements for investigation, cleanup, and abatement of discharges in SWRCB Resolution No. 92-49. Application of this ARAR is discussed in Section 2.8.1.3.

Other Criteria, Advisories, or Guidance To Be Considered for this Remedial Action (TBCs). There are no TBCs for the DRMO Trench Area groundwater.

2.10.3.3 Cost Effectiveness. The selected remedy (natural attenuation with source removal) is the most cost effective alternative to provide overall protection of human health and the environment. The pump-and-treat alternative (Alternative 3) would satisfy the preference for active treatment; however, this alternative may not be practicable because full restoration of the groundwater in a reasonable amount of time is not expected because of site-specific hydrogeologic conditions. Because future groundwater use at the site is very unlikely, the high costs for the pump-and-treat alternative to potentially achieve cleanup within a shorter time period do not seem warranted. Therefore, the selected remedy is a more cost effective means of providing protection to human health and the environment.

2.10.3.4 Utilization of Permanent Solutions and Alternative Treatment (or Resource Recovery) Technologies to the Maximum Extent Practicable. Figure 2-24 summarizes the detailed analysis of the alternatives with respect to the CERCLA-mandated evaluation criteria and identifies the major trade-offs of the selected remedy. The selected remedy, Alternative 2, meets the statutory requirement to utilize permanent solutions and treatment technologies to the maximum extent practicable. Although Alternative 2, natural attenuation with source removal, does not employ active treatment, it is believed that the intrinsic remediation processes of this alternative will result in a permanent solution. Further, if the natural attenuation alternative is deemed unacceptable, the contingency alternative, pump and treat, will utilize permanent solutions and treatment technologies. The selected remedy is more implementable than the pump-and-treat alternative. The pump-and-treat alternative provides greater short-term effectiveness and reduction of TMV through treatment than the selected remedy. Due to the long time periods required for all alternatives and the potential limited performance of the pump-and-treat alternative, the long-term effectiveness and permanence of the pump-and-treat alternative is slightly but not significantly better than the selected remedy. The greater short-term effectiveness, greater reduction of TMV, and slightly better long-term effectiveness of the pump-and-treat alternative are offset by the cost effectiveness of the selected remedy.

2.10.3.5 Preference for Treatment as a Principal Element. The selected remedy does not employ active treatment of the groundwater. However, natural processes may result in degradation of contaminants to less toxic compounds.

2.11 DOCUMENTATION OF SIGNIFICANT CHANGES

The proposed plan for the DRMO Trench Area was released for public comment in August 1997. The proposed plan identified the following alternatives as the preferred alternatives for the DRMO Trench Area:

<u>DRMO Open Trench Soil</u>

Alternative 3 - SVE and Bioventing

<u>Burn and Debris Area Soil</u>

Alternative 2 - Excavation and Off-Site Disposal

<u>DRMO Trench Area Groundwater</u>

Alternative 2 - Natural Attenuation with Source Removal

Based on the absence of any new information or public comments during the public comment period, it was determined that no significant changes to the selected remedies outlined in the proposed plan were necessary.

3.0 RESPONSIVENESS SUMMARY

The public comment period for the proposed plan at the DRMO Trench Area at Sierra Army Depot began on August 18, 1997 and expired on September 17, 1997 without any written comments being received by the Army or regulatory agencies. The public meeting presenting the proposed plan occurred on September 3, 1997. Oral comments were received during the public meeting. However, it should be noted that the power went out during the meeting causing the tape recorder to not function; thus, the public was requested to submit written comments re-stating their oral comments. A meeting report describing the items presented during the public meeting, oral comments received, and oral responses to comments during the meeting, has been made part of the Administrative Record. The Army's formal responses to the oral comments received during the public meeting are presented below.

1. Comment: Regarding the natural attenuation alternative, what will happen if groundwater standards change?

   Army Response: The natural attenuation alternative will be reevaluated, as appropriate.

2. Comment: Has the Army and/or State evaluated the effects on the natural attenuation alternative due to groundwater pumping at Fish Springs Ranch?

   Army Response: The Army did not evaluate the effects of groundwater pumping at Fish Springs Ranch as part of the feasibility study and ROD/RAP prepared for the DRMO Trench Area.

3. Comment: What will happen to a domestic well (120 feet deep) located 3 miles from Sierra Army Depot if Fish Springs Ranch pumps groundwater?

   Army Response: See response to comment #2.

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